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OBSERVATIONS

ON

MOUNT VESUVIUS, MOUNT ETNA, AND OTHER VOLCANOS:

IN

A SERIES OF LETTERS,

Addreſſed to THE ROYAL SOCIETY,

From the Honourable Sir W. HAMILTON,

K. B. F. R. S.

His Majeſty's Envoy Extraordinary and Plenipotentiary
at the Court of NAPLES.

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To which are added,

Explanatory NOTES by the AUTHOR,
hitherto unpubliſhed.

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THE EDITOR

TO

THE PUBLIC.

HAVING mentioned to Sir WILLIAM HAMILTON the general Deſire of all Lovers of Natural Hiſtory, that his Letters upon the Subject of VOLCANOS ſhould be collected together in one Volume, particularly for the Convenience of ſuch as may have an Opportunity of viſiting the curious Spots deſcribed in them: He was not only pleaſed to approve of my having undertaken this Publication, but has likewiſe favored with the additional explanatory Notes and Drawings,

The Publick's moſt obliged,

and devoted

humble Servant,

T. CADELL.

OBSER-

OBSERVATIONS
ON
MOUNT VESUVIUS, &c.

LETTER I.

To the Right Honourable the Earl of MORTON,
Preſident of the Royal Society.

My LORD, Naples, June 10, 1766.

AS I have attended particularly to the various changes of Mount Veſuvius, from the 17th of November 1764, the day of my arrival at this capital; I flatter myſelf, that my obſervations will not be unacceptable to your Lordſhip, eſpecially as this Volcano has lately made a very conſiderable eruption. I ſhall confine myſelf merely to the many extraordinary appearances that have come under my own inſpection, and leave their explanation to the more learned in Natural Philoſophy.

During the firſt twelvemonth of my being here, I did not perceive any remarkable alteration in the mountain; but I obſerved, the ſmoke from the Volcano was much more conſiderable in bad weather than when it was fair [a]; and I often heard (even at Naples, ſix miles from Veſuvius) in bad weather, the inward exploſions of the mountain. When I have been at the top of Mount Veſuvius in fair weather, I have ſometimes found ſo little ſmoke that I have been able to ſee far down the mouth of the Volcano, the ſides of which were incruſted with ſalts and minerals of various colors, white, green, deep and pale yellow. The ſmoke that iſſued from the mouth of the Volcano in bad weather was white, very moiſt, and not near ſo offenſive as the ſulphureous ſteams from various cracks on the ſides of the mountain.

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[a] Having reflected ſince upon this circumſtance, I rather believe that the weight of the atmoſphere in bad weather preventing the free diſſipation of the ſmoke, and collecting it over the crater, gives it the appearance of being more conſiderable; whereas in fine weather the ſmoke is diſperſed ſoon after its emiſſion. It is, however, the common-received opinion at Naples (and from my own obſervation is, I believe, well founded), that when Veſuvius grumbles, bad weather is at hand. The ſea of the Bay of Naples, being particularly agitated and ſwelling ſome hours before the arrival of a ſtorm, may very probably force itſelf into crevices, leading to the bowels of the Volcano, and, by cauſing a new fermentation, produce thoſe exploſions and grumblings.

Towards the month of September laſt, I perceived the ſmoke to be more conſiderable, and to continue even in fair weather; and in October I perceived ſometimes a puff of black ſmoke ſhoot up a conſiderable height in the midſt of the white, which ſymptom of an approaching eruption grew more frequent daily; and ſoon after, theſe puffs of ſmoke appeared in the night tinged like clouds with the ſetting ſun.

About the beginning of November, I went up the mountain; it was then covered with ſnow, and I perceived a little hillock of ſulphur had been thrown up, ſince my laſt viſit there, within about forty yards of the mouth of the Volcano; it was near ſix feet high, and a light blue flame iſſued conſtantly from its top. As I was examining this phænomenon, I heard a violent report, and ſaw a column of black ſmoke, followed by a reddiſh flame, ſhoot up with violence from the mouth of the Volcano; and preſently fell a ſhower of ſtones, one of which, falling near me, made me retire with ſome precipitation, and alſo rendered me more cautious of approaching too near, in my ſubſequent journies to Veſuvius.

From November to the 28th of March, the date of the beginning of this erruption, the ſmoke increaſed, and was mixed with aſhes, which fell, and did great damage to the vineyards in the neighbourhood of the mountain [b]. A few days before the eruption I ſaw (what Pliny the younger mentions having ſeen, before that eruption of Veſuvius which proved fatal to his uncle) the black ſmoke take the form of a pine-tree. The ſmoke, that appeared black in the day-time, for near two months before the eruption, had the appearance of flame in the night.

On Good Friday, the 28th of March, at 7 o'clock at night, the lava began to boil over the mouth of the Volcano, at firſt in one ſtream; and ſoon after, dividing itſelf into two, it took its courſe towards Portici. It was preceded by a violent exploſion, which cauſed a partial earthquake in the neighbourhood of the mountain, and a ſhower of red hot ſtones and

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[b] Theſe aſhes deſtroy the leaves and fruit, and are greatly detrimental to vegetation for a year or two; but are certainly of great ſervice to the land in general, and are among the principal cauſes of that very great fertility which is remarkable in the neighbourhood of Volcano's.

cinders

cinders were thrown up to a conſiderable height. Immediately upon ſight of the lava, I left Naples, with a party of my countrymen, whom I found as impatient as myſelf to ſatisfy their curioſity in examining ſo curious an operation of nature, I paſſed the whole night upon the mountain; and obſerved that, though the red hot ſtones were thrown up in much greater number and to a more conſiderable height than before the appearance of the lava, yet the report was much leſs conſiderable than ſome days before the eruption. The lava ran near a mile in an hour's time, when the two branches joined in a hollow on the ſide of the mountain, without proceeding farther. I approached the mouth of the Volcano, as near as I could with prudence; the lava had the appearance of a river of red hot and liquid metal, ſuch as we ſee in the glaſs-houſes, on which were large floating cinders, half lighted, and rolling one over another with great precipitation down the ſide of the mountain, forming a moſt beautiful and uncommon caſcade; the color of the fire was much paler and more bright the firſt night than the ſubſequent nights, when it became of a deep red, probably owing to its having been more impregnated with ſulphur at firſt than afterwards. In the day-time, unleſs you are quite cloſe, the lava has no appearance of fire; but a thick white ſmoke marks its courſe.

The 29th, the mountain was very quiet, and the lava did not continue. The 30th, it began to flow again in the ſame direction, whilſt the mouth of the Volcano threw up every minute a girandole of red hot ſtones, to an immenſe height. The 31ſt, I paſſed the night upon the mountain: the lava was not ſo conſiderable as the firſt night; but the red hot ſtones were perfectly tranſparent, ſome of which, I dare ſay of a ton weight, mounted at leaſt two hundred feet perpendicular, and fell in, or near, the mouth of a little mountain, that was now formed by the quantity of aſhes and ſtones, within the great mouth of the Volcano, and which made the approach much ſafer than it had been ſome days before, when the mouth was near half a mile in circumference, and the ſtones took every direction. Mr. Hervey, brother to the Earl of Briſtol, was very much wounded in the arm ſome days before the eruption, having approached too near; and two Engliſh gentlemen with him were alſo hurt. It is impoſſible to deſcribe the beautiful appearance of theſe girandoles of red hot ſtones, far ſurpaſſing the moſt aſtoniſhing artificial fire-work.

From the 31ſt of March to the 9th of April, the lava continued on the ſame ſide of the mountain, in two, three, and ſometimes four branches, without deſcending much lower than the firſt night. I remarked a kind of intermiſſion in the fever of the mountain [*c*], which ſeemed to

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[c] In the ſubſequent eruptions of Veſuvius, I have conſtantly remarked ſomething of the ſame nature, as appears in my account of the great eruption of 1767.

return with violence every other night. On the 10th of April at night, the lava diſappeared on the ſide of the mountain towards Naples, and broke out with much more violence on the ſide next the *Torre dell' Annunciata.*

I paſſed the whole day and the night of the 12th upon the mountain, and followed the courſe of the lava to its very ſource: it burſt out of the ſide of the mountain, within about half a mile of the mouth of the Volcano, like a torrent, attended with violent exploſions, which threw up inflamed matter to a conſiderable height, the adjacent ground quivering like the timbers of a water-mill; the heat of the lava was ſo great, as not to ſuffer me

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I have found the ſame remark in many accounts of former eruptions of Veſuvius: in the very curious one of the formation of a new mountain near Puzzole, in 1538, (as may be ſeen in my letter to Dr. Maty, Oct. 16, 1770,) the ſame obſervation is made. This phænomenon is well worthy of a curious inquiry, which might give ſome light into the theory of the earth, of which, I believe, we are very ignorant.

to approach nearer than within ten feet of the ſtream, and of ſuch a conſiſtency (though it appeared liquid as water) as almoſt to reſiſt the impreſſion of a long ſtick, with which I made the experiment; large ſtones thrown on it with all my force did not ſink, but, making a ſlight impreſſion, floated on the ſurface, and were carried out of ſight in a ſhort time; for, notwithſtanding the conſiſtency of the lava, it ran with amazing velocity; I am ſure, the firſt mile with a rapidity equal to that of the river Severn, at the paſſage near Briſtol. The ſtream at its ſource was about ten feet wide, but ſoon extended itſelf, and divided into three branches; ſo that theſe rivers of fire, communicating their heat to the cinders of former lavas, between one branch and the other, had the appearance at night of a continued ſheet of fire, four miles in length, and in ſome parts near two in breadth. Your Lordſhip may imagine the glorious appearance

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pearance of this uncommon ſcene, ſuch as paſſes all deſcription.

The lava, after having run pure for about a hundred yards, began to collect cinders, ſtones, &c. and a ſcum was formed on its ſurface, which in the day-time had the appearance of the river Thames, as I have ſeen it after a hard froſt and great fall of ſnow, when beginning to thaw, carrying down vaſt maſſes of ſnow and ice. In two places the liquid lava totally diſappeared, and ran in a ſubterraneous paſſage for ſome paces; then came out again pure, having left the ſcum behind. In this manner it advanced to the cultivated parts of the mountain; and I ſaw it, the ſame night of the 12th, unmercifully deſtroy a poor man's vineyard, and ſurround his cottage, notwithſtanding the oppoſition of many images of St. Januarius, that were placed upon the cottage, and tied to almoſt every vine. The lava, at the fartheſt extremity from its ſource, did not appear liquid, but like a heap of red hot coals, forming a wall in ſome places ten or twelve feet high, which rolling from the top ſoon formed another wall, and ſo on, advancing ſlowly, not more than about thirty feet in an hour [*d*].

[*d*] I am convinced, that it might be very practicable to divert the courſe of a lava when in this ſtate, by preparing a new bed for it, as is practiſed with rivers. I was mentioning this idea at Catania in Sicily, when I was aſſured, that it had been done with ſucceſs during the great eruption of Etna, in 1669; that the lava was directing its courſe towards the walls of Catania, and advancing ſlowly like the abovementioned, when they prepared a channel for it round the walls of the town, and turned it into the ſea; that a ſucceſſion of men, covered with ſheep-ſkins wetted, were employed to cut through the tough flanks of the lava, till they made a paſſage for that in the centre (which was in perfect fuſion) to diſgorge itſelf into the channel prepared for it. A book I have ſince met with gives the ſame account of this curious operation, it is intituled, *Relatione del nuovo incendio fatto da Mongibello* 1669. *Meſſina*; *Giuſeppe Biſagni*, 1670. His Sicilian Majeſty's palace at Portici, and the valuable collection of antiquities that have been recovered from beneath the deſtructive lava's of Veſuvius, are in imminent danger of being overwhelmed again by the next that ſhall take its courſe

The mouth of the Volcano has not thrown up any large ſtones ſince the ſecond eruption of lava on the 10th of April; but has thrown up quantities of ſmall aſhes and pumice ſtones, that have greatly damaged the neighbouring vineyards. I have been ſeveral times at the mountain ſince the 12th; but, as the eruption was in its greateſt vigour at that time, I have ventured to dwell on, and I fear tire your Lordſhip with, the obſervations of that day.

In my laſt viſit to Mount Veſuvius, the 3d of June, I ſtill found that the lava continued; but the rivers were become rivulets, and had loſt much of their rapidity. The quantity of matter thrown out by this eruption is greater than that of the laſt in the year 1760; but the da-

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that way; whereas, by taking a level, cutting away and raiſing ground, as occaſion might require, the palace and muſeum would, in all probability, be inſured, at leaſt againſt one eruption; and, indeed, I once took the liberty of communicating this idea to the King of Naples, who ſeemed to approve of it.

mage to the cultivated lands is not ſo conſiderable, owing to its having ſpread itſelf much more, and its ſource being at leaſt three miles higher up. This eruption ſeems now to have exhauſted itſelf; and I expect in a few days to ſee Veſuvius reſtored to its former tranquillity.

Mount Etna in Sicily broke out the 27th of April; and made a lava, in two branches, at leaſt ſix miles in length, and a mile in breadth; and, according to the deſcription given me by Mr. Wilbraham, (who was there, after having ſeen with me part of the eruption of Mount Veſuvius) reſembles it in every reſpect, except that Mount Etna, at the place from whence the lava flowed (which was twelve miles from the mouth of the Volcano), threw up a fountain of liquid inflamed matter to a conſiderable height; which, I am told, Mount Veſuvius has done in former eruptions.

I beg pardon for having taken up ſo much of your time; and yet I flatter myſelf,

ſelf, that my deſcription, which I aſſure your Lordſhip is not exaggerated, will have afforded you ſome amuſement. I have the honour to be,

My LORD,

Your Lordſhip's

Moſt obedient

and moſt humble ſervant,

WILLIAM HAMILTON.

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Naples, February 3, 1767.

SINCE the account of the eruption of Mount Veſuvius, which I had the honour of giving to your Lordſhip, in my letter of the 10th of June laſt; I have only to add, that the lava continued till about the end of November, without doing any great damage, having taken its courſe over antient lavas. Since the ceſſation of this eruption, I have examined the crater, and the crack on the ſide of the mountain towards *Torre dell' Anonciata*, about a hundred yards from the crater from whence this lava iſſued: and I found therein ſome very curious ſalts and ſulphurs; a ſpecimen of each ſort I have put into bottles myſelf, even upon the mountain, that they might not loſe any of their force, and have ſent them in a box directed to your Lordſhip, as you will ſee by the bill of lading: I am ſure, you will have a pleaſure in ſeeing them analyzed [e]. I have alſo packed in the ſame box ſome lava, and cinders, of the laſt eruption; there is one piece in particular very curious, having the exact appearance of a cable petrified. I ſhall be very happy if theſe trifles ſhould afford your Lordſhip a moment's amuſement.

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[e] The late Lord Morton was pleaſed to give theſe ſpecimens to Dr. Morris, who has made ſeveral chemical experiments on them, the reſult of which will be communicated to the Royal Society.

It is very extraordinary, that I cannot find, that any chemiſt here has ever been at the trouble of analyzing the productions of Veſuvius.

The deep yellow, or orange-color ſalts, of which there are two bottles, I fetched out of the very crater of the mountain, in a crevice that was indeed very hot. It ſeems to me to be powerful, as it turns ſilver black in an inſtant, but has no effect upon gold. If your Lordſhip pleaſes, I will ſend you by another opportunity ſpecimens of the ſulphurs and ſalts of the *Solfa terra*, which ſeem to be very different from theſe.

Within theſe three days, the fire has appeared again on the top of Veſuvius, and earthquakes have been felt in the neighbourhood of the mountain. I was there on Saturday with my nephew Lord Greville; we heard moſt dreadful inward grumblings, rattling of ſtones, and hiſſing;

and were obliged to leave the crater very ſoon, on account of the emiſſion of ſtones. The black ſmoke aroſe, as before the laſt eruption; and I ſaw every ſymptom of a new eruption, of which I ſhall not fail to give your Lordſhip an exact account,

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LETTER II.

To the Right Honourable the Earl of MORTON,
Preſident of the Royal Society.

My LORD, Naples, December 29, 1767.

THE favourable reception, which my account of laſt year's eruption of Mount Veſuvius met with from your Lordſhip; the approbation which the Royal Society was pleaſed to ſhew, by having ordered the ſame to be printed in their Philoſophical Tranſactions; and your Lordſhip's commands, in your letter of the 3d inſtant; encourage me to trouble you with a plain narrative of what came immediately under my obſervation, during the late violent eruption, which began October 19, 1767, and is reckoned to be the twenty-ſeventh ſince that, which, in the time of Titus, deſtroyed Herculaneum and Pompeii.

The eruption of 1766 continued in ſome degree till the 10th of December, about nine months in all [f]; yet in that ſpace of time the mountain did not caſt up a third of the quantity of lava, which it diſgorged in only ſeven days, the term of this laſt eruption. On the 15th of December, laſt year, within the ancient crater of Mount Veſuvius, and about twenty feet deep, there was a cruſt, which formed a plain, not unlike the Solfa terra in miniature; in the midſt of this plain was a little mountain, whoſe top did not riſe ſo high as the rim of the ancient crater. I went into this plain, and up the little mountain, which was perforated, and ſerved as the principal chimney to the Volcano: when I threw down large ſtones, I could hear that they met with many obſtructions in their way, and could count a hundred moderately before they reached the bottom.

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[f] From what I have ſeen and read of eruptions of Veſuvius and Etna, I am convinced that Volcano's lie dormant for ſeveral years, nay even for centuries, as probably was the caſe of Veſuvius before its eruption in the reign of Titus, and certainly was ſo before that of the year 1631. When I arrived at Naples in 1764, Veſuvius was quiet, very ſeldom ſmoke was viſible on its top; in the year 1766, it ſeemed to take fire, and has never ſince been three months without either throwing up red hot ſtones, or diſgorging ſtreams of lava, nor has its crater been ever free from ſmoke. At Naples, when a lava appears, and not till then, is it ſtyled an eruption; whereas I look upon the five nominal eruptions I have been witneſs to, from March 1766 to May 1771, as, in effect, but one continued eruption.

Veſuvius was quiet till March 1767, when it began to throw up ſtones from time to time; in April, the throws were more frequent, and at night fire was viſible on the top of the mountain; or, more properly ſpeaking, the ſmoak, which hung over the crater, was tinged by the reflection of the fire within the Volcano. Theſe repeated throws of cinders, aſhes, and pumice ſtones, increaſed the little mountain ſo much, that in May its top was viſible above the rim of the ancient crater. The 7th of Auguſt, there iſſued a ſmall ſtream of lava, from a breach in the ſide of this little mountain, which gradually filled the valley between it and the ancient crater; ſo that, the 12th of September, the lava overflowed the ancient crater, and took its courſe down the ſides of the great mountain; by this time, the throws were much more frequent, and the red hot ſtones went ſo high as to take up ten ſeconds in their fall. Padre Torre, a great obſerver of Mount Veſuvius, ſays they went up above a thouſand feet.

The 15th of October, the height of the little mountain (formed in about eight months) was meaſured by Don Andrea Pigonati, a very ingenious young man, in his Sicilian Majeſty's ſervice, who aſſured me that its height was 185 French feet.

From my villa, ſituated between Herculaneum and Pompeii, near the convent of the Calmaldoleſe (marked 7 in Plate I.) I had watched the growing of this little mountain; and, by taking drawings of it from time to time, I could perceive its increaſe moſt minutely. I make no doubt but that the whole of Mount Veſuvius has been formed in the ſame manner; and as theſe obſervations ſeem to me to account for the various irregular ſtrata, which are met with in the neighbourhood of Volcanos, I have ventured to incloſe, for your Lordſhip's inſpection, a copy of the above-mentioned drawings. (Plate III.)

The lava continued to run over the ancient crater in ſmall ſtreams, ſometimes on one ſide, and ſometimes on another, till the 18th of October, when I took particular notice that there was not the leaſt lava to be ſeen; owing, I imagine, to its being employed in forcing its way towards the place where it burſt out the following day. As I had, contrary to the opinion of moſt people here, foretold the approaching eruption [g], and had obſerved a great fermentation in the mountain after the heavy rains which fell the 13th and 14th of October; I was not ſurprized, on the 19th following, at ſeven of the clock in the morning, to perceive from my villa every ſymptom of the eruption being juſt at hand. From the top of the little mountain iſſued a thick black ſmoak, ſo thick that it ſeemed to have difficulty in forcing its way out; cloud after cloud mounted with a haſty ſpiral motion, and every minute a volley of great ſtones were ſhot up to an immenſe height in the midſt of theſe clouds; by degrees, the ſmoak

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[g] It is certain, that, by conſtant attention to the ſmoak that iſſues from the crater, a very good gueſs may be given as to the degree of fermentation within

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the Volcano. By this alone I foretold * the two laſt eruptions, and, by another very ſimple obſervation, I pointed out, ſome time before, the very ſpot from whence the lava has iſſued. When the cone of Veſuvius was covered with ſnow, I had remarked a ſpot on which it would not lie: concluding very naturally that this was the weakeſt part of the cone, and that the heat from within prevented the ſnow from lying, it was as natural to imagine that the lava, ſeeking a vent, would force this paſſage ſooner than another; and ſo indeed it came to paſs.

[*] See Letter I. p. 18.

took the exact ſhape of a huge pine-tree, ſuch as Pliny the younger deſcribed in his letter to Tacitus, where he gives an account of the fatal eruption in which his uncle periſhed [*b*]. This column of black ſmoak, after having mounted an extraordinary height, bent with the wind towards Caprea, and actually reached over that iſland, which is not leſs than twenty-eight miles from Veſuvius.

I warned my family not to be alarmed, as I expected there would be an earthquake at the moment of the lava's burſting out; but before eight of the clock in the morning I perceived that the mountain had opened a mouth, without noiſe, about a hundred yards lower than the ancient crater, on the ſide towards the Monte di Somma; and I plainly perceived, by a white ſmoak, which always accompanies the lava, that it had forced its way out: as ſoon as it had vent, the ſmoak no longer came out with that violence from the top. As I imagined that there would be no danger in approaching the mountain when the lava had vent, I went up immediately, accompanied by one peaſant only. I paſſed the hermitage (3. in Plate I.), and proceeded as far as the ſpot marked (×), in the valley between the mountain of Somma and that of Veſuvius, which is called Atrio di Cavallo. I was making my obſervations upon the lava, which had already, from the ſpot (E) where it firſt broke out, reached the valley; when, on a ſudden, about noon, I heard a violent noiſe within the mountain, and at the ſpot (C), about a quarter of a mile off the place where I ſtood, the mountain ſplit;

[*b*] Theſe are his words: "Nubes (incertum procul "intuentibus ex quo monte Veſuvium fuiſſe poſtea "cognitum eſt) oriebatur, cujus ſimilitudinem & formam, non alia magis arbor, quam pinus expreſſerit. "Nam longiſſimo veluti trunco elata in altum, qui- "buſdam ramis diffundebatur, credo quia recenti ſpiritu "evecta, dein ſeneſcente eo deſtituta, aut etiam pondere "ſuo victa, in latitudinem evaneſcebat: candida inter- "dum, interdum ſordida & maculoſa, prout terram "cineremve ſuſtulerat." Plin. lib. vi. ep. 16.

and, with much noiſe, from this new mouth, a fountain of liquid fire ſhot up many feet high, and then, like a torrent, rolled on directly towards us. The earth ſhook at the ſame time that a volley of pumice ſtones fell thick upon us; in an inſtant, clouds of black ſmoak and aſhes cauſed almoſt a total darkneſs; the exploſions from the top of the mountain were much louder than any thunder I ever heard, and the ſmell of the ſulphur was very offenſive. My guide, alarmed, took to his heels; and I muſt confeſs, that I was not at my eaſe. I followed cloſe, and we ran near three miles without ſtopping; as the earth continued to ſhake under our feet, I was apprehenſive of the opening of a freſh mouth, which might have cut off our retreat. I alſo feared that the violent exploſions would detach ſome of the rocks off the mountain of Somma, under which we were obliged to paſs; beſides, the pumice-ſtones, falling upon us like hail, were of ſuch a ſize as to cauſe a diſagreeable ſenſation upon the part where they fell. After having taken breath, as the earth ſtill trembled greatly, I thought it moſt prudent to leave the mountain, and return to my villa; where I found my family in a great alarm, at the continual and violent exploſions of the Volcano, which ſhook our houſe to its very foundation, the doors and windows ſwinging upon their hinges. About two of the clock in the afternoon another lava forced its way out of the ſame place from whence came the lava laſt year, at the ſpot marked B (in Plate II.); ſo that the conflagration was ſoon as great on this ſide of the mountain, as on the other, which I had juſt left.

The noiſe and ſmell of ſulphur increaſing, we removed from our villa to Naples; and I thought proper, as I paſſed by Portici, to inform the Court of what I had ſeen; and humbly offered it as my opinion, that his Sicilian Majeſty ſhould leave the neighbourhood of the threatening mountain. However, the Court did not leave Portici till about twelve of the clock, when the lava had reached as far as (4. in Plate I.)—I obſerved, in my way to Naples, which was in leſs than two hours after I had left the mountain, that the lava had actually covered three miles of the very road through which we had retreated. It is aſtoniſhing that it ſhould have run ſo faſt; as I have ſince ſeen, that the river of lava, in the Atrio di Cavallo, was ſixty and ſeventy feet deep, and in ſome places near two miles broad. When his Sicilian Majeſty quitted Portici, the noiſe was greatly increaſed; and the concuſſion of the air from the exploſions was ſo violent, that, in the King's palace, doors and windows were forced open, and even one door there, which was locked, was nevertheleſs burſt open. At Naples, the ſame night, many windows and doors flew open; in my houſe, which is not on the ſide of the town next Veſuvius, I tried the experiment of unbolting my windows [*i*], when they flew wide open upon every exploſion of the mountain. Beſides theſe exploſions, which were very frequent, there was a continued ſubterraneous and violent rumbling noiſe, which laſted this night about five hours. I have imagined, that this extraordinary noiſe might be owing to the lava in the bowels of the mountain having met with a depoſition of rain water; and that the conflict between the fire and the water may, in ſome meaſure, account for ſo extraordinary a crackling and hiſſing noiſe. Padre Torre, who has wrote ſo much and ſo well upon the ſubject of Mount Veſuvius, is alſo of my opinion. And indeed it is natural to imagine, that there may be rain-water lodged in many of the caverns of the mountain; as, in the great eruption of Mount Veſuvius in 1631, it is well atteſted, that ſeveral towns, among which Portici and Torre del Greco, were deſtroyed, by a torrent of boiling water having burſt out of the mountain with the lava, by which thouſands of lives were loſt. About four years ago, Mount Etna in Sicily threw up hot water alſo, during an eruption.

[*i*] The windows at Naples open like folding doors.

The confuſion at Naples this night cannot be deſcribed; his Sicilian Majeſty's haſty retreat from Portici added to the alarm; all the churches were opened and filled; the ſtreets were thronged with proceſſions of ſaints: but I ſhall avoid entering upon a deſcription of the various ceremonies that were performed in this capital, to quell the fury of the turbulent mountain.

Tueſday the 20th, it was impoſſible to judge of the ſituation of Veſuvius, on account of the ſmoak and aſhes, which covered it entirely, and ſpread over Naples alſo, the ſun appearing as through a thick London fog, or a ſmoaked glaſs; ſmall aſhes fell all this day at Naples. The lavas on both ſides of the mountain ran violently; but there was little or no noiſe till about nine o'clock at night, when the ſame uncommon rumbling began again, accompanied with exploſions as before, which laſted about four hours; it ſeemed as if the mountain would ſplit in pieces; and, indeed, it opened this night almoſt from the ſpot E to C (in Plate I.). The annexed plans were taken upon the ſpot at this time, when the lavas were at their height; and I do not think them exaggerated. The Pariſian barometer was, as yeſterday, at 279, and Fahrenheit's thermometer at 70 degrees; whereas, for ſome days preceding the eruption, it had been at 65 and 66. During the confuſion of this night, the priſoners in the public jail attempted to eſcape, having wounded the jailer; but were prevented by the troops. The mob alſo ſet fire to the Cardinal Archbiſhop's gate, becauſe he refuſed to bring out the relicks of Saint Januarius.

Wedneſday 21ſt, was more quiet than the preceding days, though the lavas ran briſkly. Portici was once in ſome danger, had not the lava taken a different courſe when it was only a mile and a half from it; towards night, the lava ſlackened.

Thurſday 22d, about ten of the clock in the morning, the ſame thundering noiſe began again, but with more violence than the preceding days; the oldeſt men declared, they had never heard the like; and, indeed, it was very alarming: we were in expectation every moment of ſome dire calamity. The aſhes, or rather ſmall cinders, ſhowered down ſo faſt, that the people in the ſtreets were obliged to uſe umbrellas, or flap their hats; theſe aſhes being very offenſive to the eyes. The tops of the houſes, and the balconies, were covered above an inch thick with theſe cinders [*k*].

[*k*] In ſeveral accounts of former eruptions of Veſuvius, I have found mention of the aſhes falling at a much greater diſtance; that, in the year 472 and 473, they had reached Conſtantinople: Dio ſays, that during the eruption of Veſuvius in the time of Titus— "Tantus fuit pulvis ut ab eo loco in Africam et Syriam et "Ægyptum penetraverit." A book printed at Lecce, in the kingdom of Naples, in MDCXXXII, and intituled, *Diſcorſo ſopra l'origine de fuochi gettati dal Monte Veſuvio*

Ships at ſea, twenty leagues from Naples, were alſo covered with them, to the great

di Gio Franceſco Sorrata Spinola Galateo, ſays, that the 16th of December, 1631, the very day of the great eruption of Veſuvius (though perfectly calm), it rained aſhes at Lecce, which is nine days journey from the mountain; that the day was darkened by them, and that they covered the ground three inches deep; that aſhes of a different quality fell at Bari the ſame day; and that at both theſe places the inhabitants were very greatly alarmed, not being able to conceive the occaſion of ſuch a phænomenon. Antonio Buliſon, in his account of the ſame eruption, ſays, that the aſhes fell, and lay ſeveral inches deep at Ariano in Puglia; and I have been aſſured, by many perſons of credit at Naples, that they have been ſenſible of the fall of aſhes, during an eruption, at above two hundred miles diſtance from Veſuvius. The Abbate Giulio Ceſare Bracini, in his account of the eruption of Veſuvius, in 1631, ſays, that the height of the column of ſmoak and aſhes, taken from Naples by a quadrant, was upwards of thirty miles. Though ſuch uncertain calculations demand but little attention, yet, by what I have ſeen, I am convinced, that in great eruptions the aſhes are ſent up to ſo great a height as to meet with extraordinary currents of air, which is the moſt probable way of accounting for their having been carried to ſo great a diſtance in a few hours. In a book, intituled, *Salvatoris Varonis Veſuviani incendii Libri tres: Neapoli*, aſtoniſhment of the ſailors. In the midſt of theſe horrors, the mob, growing tumultuous and impatient, obliged the Cardinal to bring out the head of Saint Januarius, and go with it in proceſſion to the Ponte Maddalena, at the extremity of Naples, towards Veſuvius; and it is well atteſted here, that the eruption ceaſed the moment the Saint came in ſight of the mountain; it is true, the noiſe ceaſed about that time, after having laſted five hours, as it had done the preceding days.

Friday 23d, the lavas ſtill ran, and the mountain continued to throw up quantities of ſtones from its crater; there was no noiſe heard at Naples this day, and but little aſhes fell there.

MDXXXIV. I found a very poetical deſcription of the aſhes that lay in the neighbourhood of Veſuvius, after the eruption of 1631, in depth, from twenty to a hundred palms, "Quare," ſays this author, "multi patrio "in ſolo requirunt patriam, et vix ibi ſe credunt vivere "ubi certo ſciant ſeſe natos, adeo totam loci ſpeciem "tempeſtas vertit."

Saturday 24th, the lava ceaſed running; the extent of the lava, from the ſpot C (Plate I.), where I ſaw it break out, to its extremity F, where it ſurrounded the chapel of Saint Vito, is above ſix miles. In the Atrio di Cavallo, and in a deep valley that lies between Veſuvius (1.) and the hermitage (3.), the lava is in ſome places near two miles broad, and in moſt places from ſixty to ſeventy feet deep; at (4.), the lava ran down a hollow way, called Foſſa grande, made by the currents of rain water; it is not leſs than two hundred feet deep, and a hundred broad; yet the lava in one place has filled it up. I could not have believed that ſo great a quantity of matter could have been thrown out in ſo ſhort a time, if I had not ſince examined the whole courſe of the lava myſelf. This great compact body will certainly retain ſome heat many months [*l*]; at this time, much rain having fallen for ſome days paſt, the lava ſmoaks, as if it ran afreſh: and about ten days ago, when I was up the mountain with Lord Stormont, we thruſt ſticks into the crevices of the lava, which took fire immediately: But to proceed with my journal.

[*l*] This conjecture has proved true; for, even in the month of April 1771, I again thruſt ſticks into ſome crevices of this lava, and they immediately took fire.

The 24th, Veſuvius continued to throw up ſtones as on the preceding days: during the whole of this eruption, it had differed in this circumſtance from the eruption of 1766, when no ſtones were thrown out of the crater from the moment the lava ran freely.

Sunday 25th, ſmall aſhes fell all day at Naples; they iſſued from the crater of the Volcano, and formed a vaſt column, as black as the mountain itſelf, ſo that the ſhadow of it was marked out on the ſurface of the ſea; continual flaſhes of forked or zig-zag lightning ſhot from this black column, the thunder of which was heard

On Mount Etna, in 1769, I obſerved the lava, that had been diſgorged in 1766, ſmoak in many parts.

in the neighbourhood of the mountain, but not at Naples; there were no clouds in the ſky at this time, except thoſe of ſmoak iſſuing from the crater of Veſuvius. I was much pleaſed with this phænomenon, which I had not ſeen before in that perfection [m].

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[m] In all accounts of great eruptions of Mount Etna and Mount Veſuvius, I have found mention of this ſort of lightning. Pliny the younger, in his ſecond letter to Tacitus upon the eruption of Veſuvius in the time of Titus, ſays, that a black and horrible cloud covered them at Miſenum (which is above fifteen miles from the Volcano), and that flaſhes of zig-zag fire, like lightning, but ſtronger, burſt from it; theſe are his words: "ab altero latere nubes atra et horrenda "ignei ſpiritus tortis vibratiſque diſcurſibus rupta, in "longas flammarum figuras dehiſcebat; fulgoribus "illæ et ſimiles et majores erant." This was evidently the ſame electrical fire, and with which I am convinced that the ſmoak of all Volcanos is pregnant. In ſeveral accounts of the great eruption of Veſuvius in 1631, mention is made of damage done by the lightning that iſſued from the column of ſmoak. Bulifon, in particular, ſays, that, in the neighbourhood of the Volcano, people were ſtruck dead in the ſame manner, as if by lightning, without having their cloaths ſinged. Pliny mentions a like inſtance,

Monday 26th, the ſmoak continued, but not ſo thick, neither were there any flaſhes of the mountain lightning. As no lava has appeared after this column of black ſmoak, which muſt have been occaſioned by ſome inward operation of fire; I am apt to think, that the lava, which ſhould naturally have followed this ſymptom, has broke its way into ſome deeper cavern, where it is ſilently brooding future miſchief; and I ſhall be much miſtaken if it does not break out a few months hence.

Tueſday 27th, no more black ſmoak, nor any ſigns of eruption.

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which ſhews that the ancients had obſerved this phænomenon; for he ſays, that at Pompeii, the day being fair, Marcus Herennius was ſtruck dead by lightning. Theſe are his words: "In Catilianis prodigiis, Pompeiano ex municipio M. Herennius Decurio *ſereno die*, fulmine ictus eſt." Plin. Hiſt. Nat. lib. II. cap. LI. The learned and ingenious Father Beccaria, at Turin, aſſured me, that he had been greatly pleaſed with my obſervations on this ſpecies of lightning, as coinciding perfectly with ſeveral of his electrical experiments.

Thus, my Lord, I have had the honor of giving your Lordſhip a faithful narrative of my obſervations during this eruption, which is univerſally allowed to have been the moſt violent of this century; and I ſhall be happy, if it ſhould meet with your approbation, and that of the Royal Society, if your Lordſhip ſhould think it worthy of being communicated to ſo reſpectable a body.

I have juſt ſent a preſent to the Britiſh Muſeum of a complete collection of every ſort of matter produced by Mount Veſuvius, which I have been collecting with ſome pains for theſe three years paſt; and it will be a great ſatisfaction to me, if, by the means of this collection, ſome of my countrymen, learned in natural hiſtory, may be enabled to make ſome uſeful diſcoveries relative to Volcanos [n].

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[n] "I am well convinced, by this collection, that "many variegated marbles, and many precious ſtones, "are the produce of Volcanos; and that there have "been Volcanos in many parts of the world, where at

I have alſo accompanied that collection with a view of a current of lava from Mount Veſuvius; it is painted with tranſparent colours, and, when lighted up with lamps behind it, gives a much better idea of Veſuvius, than is poſſible to be given by any other ſort of painting.

I have the honor to be,

My Lord,

Your Lordſhip's

Moſt obedient

and moſt humble ſervant,

William Hamilton.

" preſent there are no traces of them viſible." This is taken from a prior letter to Lord Morton, dated April 7, 1767.

PLATE I.

A. Crater of Mount Veſuvius.

B. Mouth from whence came the lava of 1766; and which opened afreſh, October 19, 1767, and produced the conflagration repreſented in Plate II.

C. The mouth which opened at 12 o'clock, October 19, 1767, whilſt I was at the ſpot marked ×; from thence came all the lava repreſented in Plate I.

D. The lava.

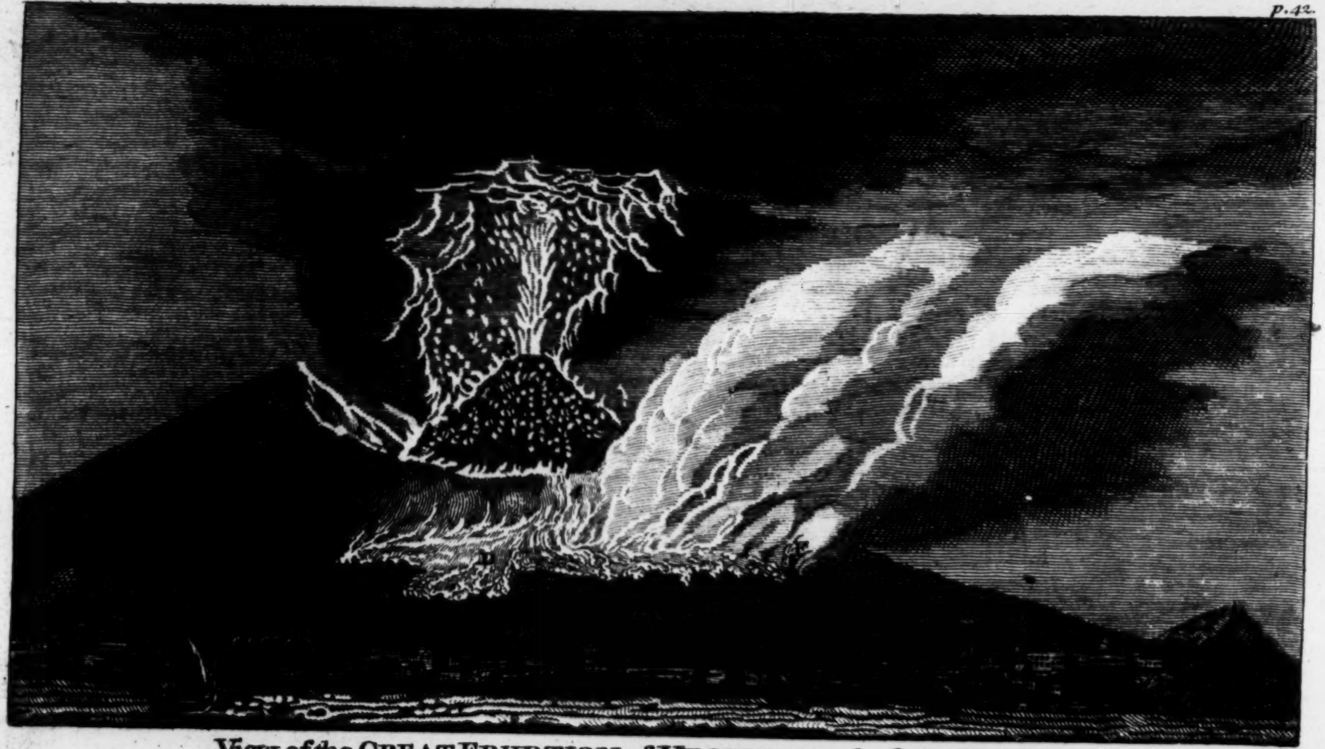
E. Mouth from whence the lava flowed at eight o'clock, October 19, when the eruption began firſt.

F. Chapel of Saint Vito, ſurrounded with lava.

1. Veſuvius.
2. Mountain of Somma.

Plate I.

p. 42.

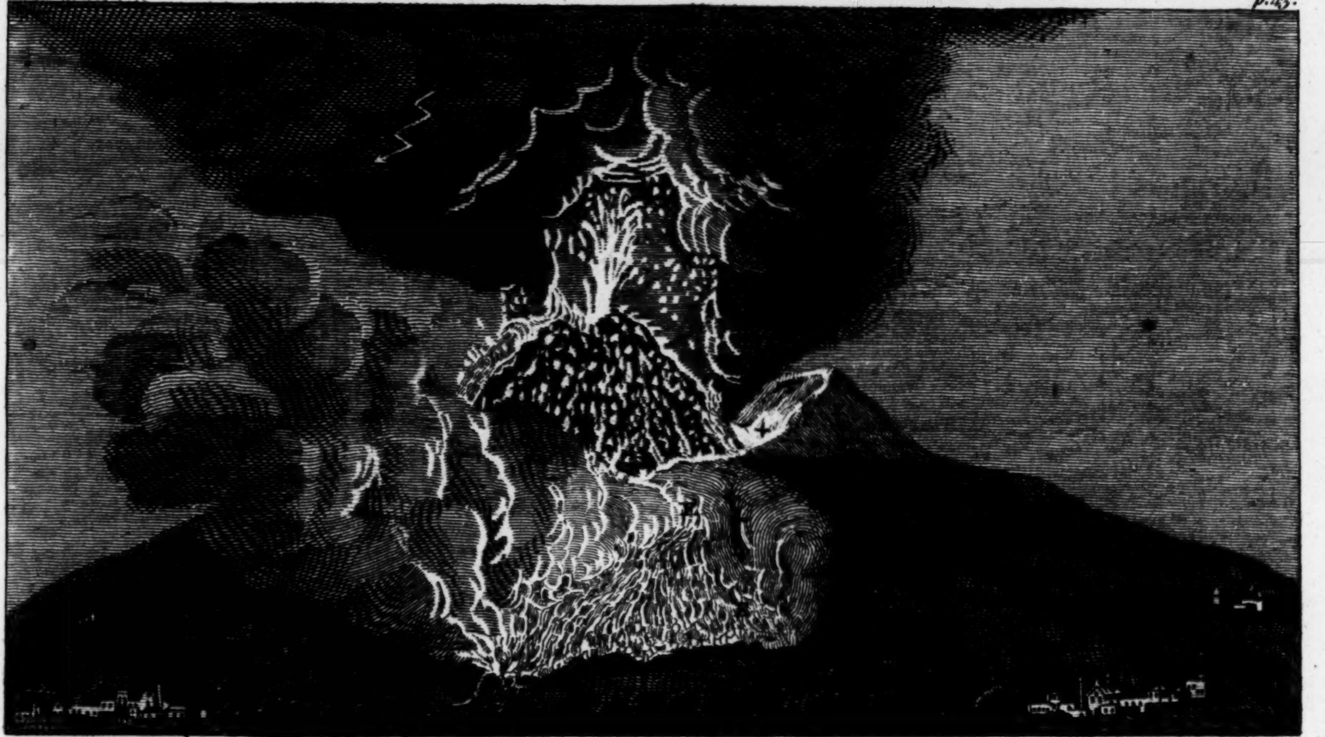


View of the GREAT ERUPTION of VESUVIUS 1767 from Portici.

B L

B L

Plate II. *p. 43.*



View of the GREAT ERUPTION of VESUVIUS 1767, from Torre dell'Annunziata.

3. Hermitage, between which and Veſuvius there is a deep valley two miles broad.
4. The Foſſa Grande.
5. His Sicilian Majeſty's Palace at Portici.
6. Church of Pugliano.
7. Calmaldoleſe Convent, near which is my Villa.
8. Saint Jorio.
9. Barra.
10. Spot, under which lies Herculaneum,

PLATE II.

A. Crater of Veſuvius.
B. Mouth, from whence came the lava of 1766, and which opened afreſh at two o'clock, October 19, 1767, and cauſed the conflagration on this ſide of the mountain.
C. Mouth which opened at 12 o'clock, October 19, 1767, whilſt I was at the

the ſpot ×, and which produced all the lava repreſented in Plan I.

D. Rivulets of lava, which flowed from the crater, and united with the great river E.

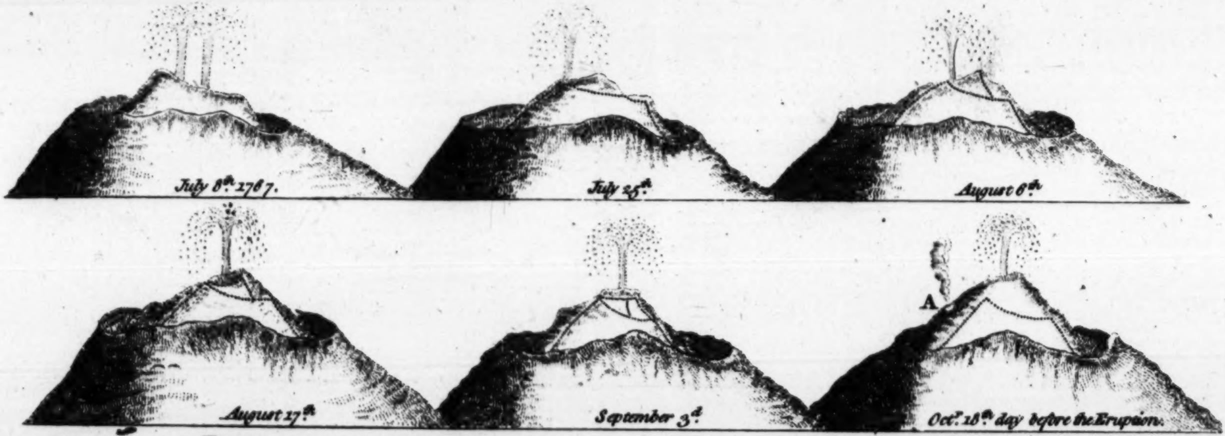
F. Extremities of the lava, about five miles from B.

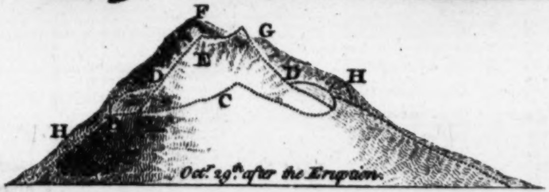
1. Mountain of Somma.
2. Mount Veſuvius.
3. Montagna di Trecaſe.
4. Trecaſe.
5. Oratorio di Boſco.
6. Ottaiano.

PLATE III.

Views of the gradual increaſe of the little mountain within the ancient crater; and of the preſent ſhape of Mount Veſuvius.

LET-


July 8th. 1767.
July 25th.
August 6th.
August 17th.
September 3d.
A
Octr. 18th. day before the Eruption.

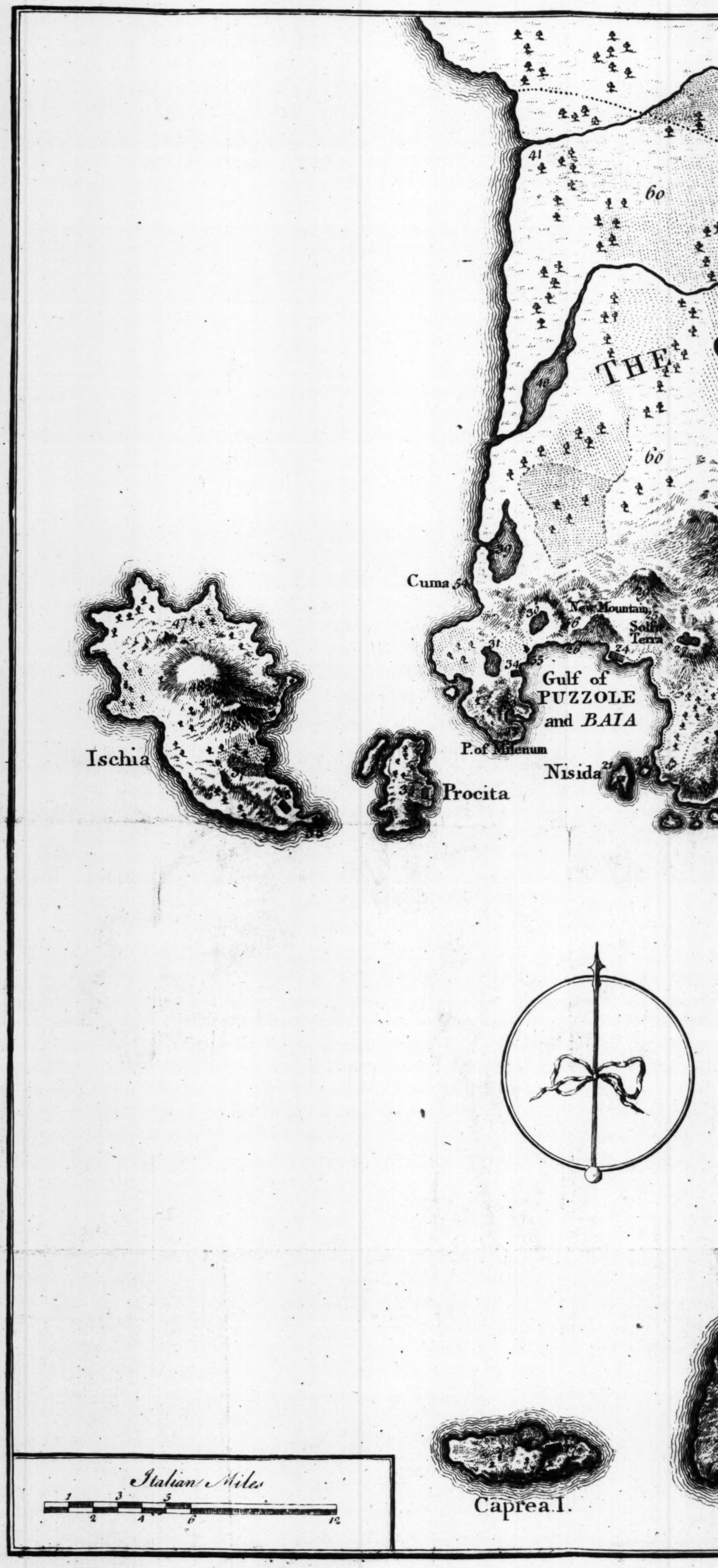


The ancient Crater of Mount Vesuvius,

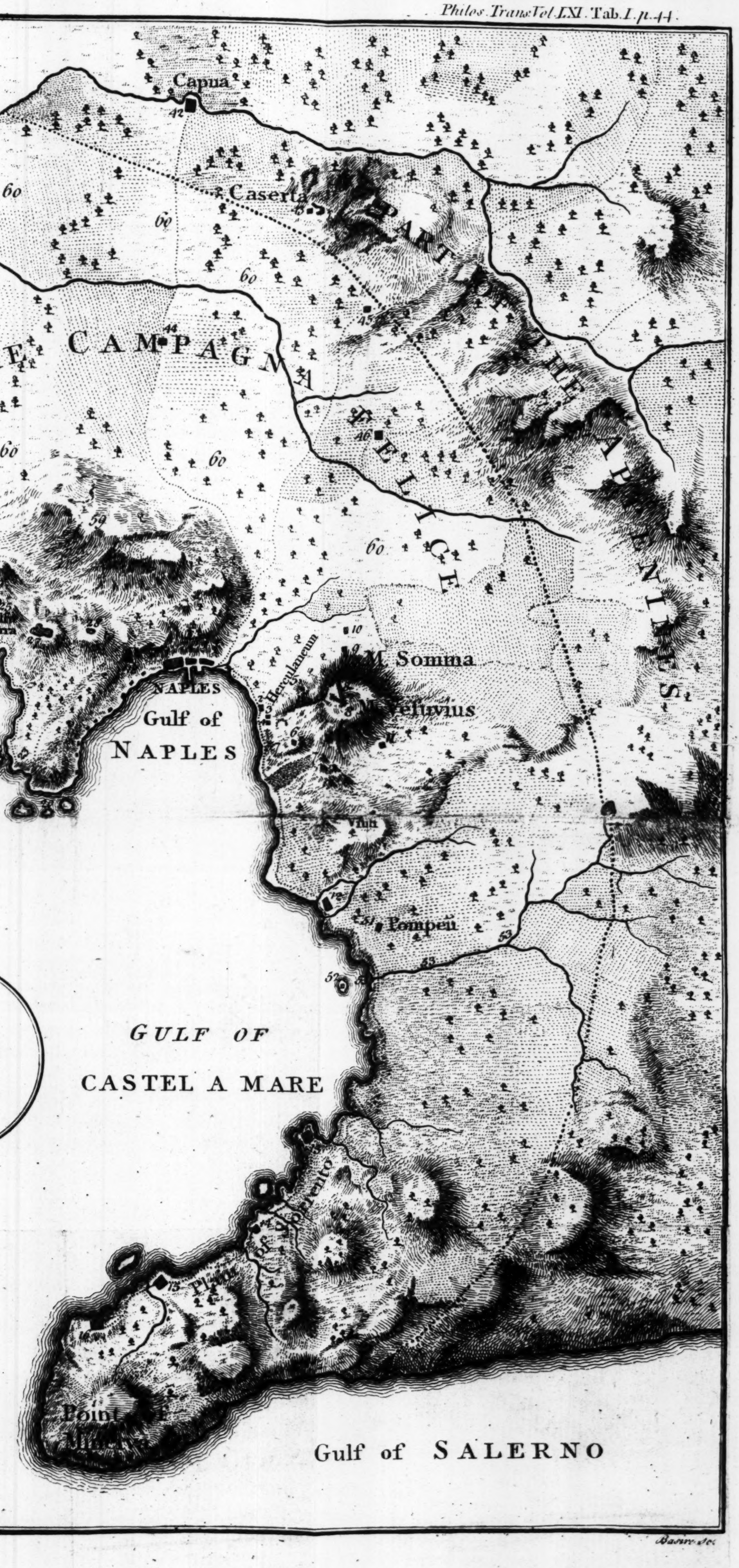
With the gradual increase of the little Mountain within the Crater.

The exteriour black line marks each increase, & the interiour dotted line shews the state of the little Mountain before that increase, so that the dotted line in the Drawing of Octr. 18th. shews the Size of the little Mountain July 8th. the little spot A. marks where the lava came out some days before the great Eruption. B.C.D. mark the ancient Crater & E. the little Mountain the day before the Eruption. F.G. is the present Crater, & the exteriour black line H.F.G. the present shape of the top of Mount Vesuvius. Since May last the Mountain is increased from B. to F. which is near 200 feet. -

B L



THE
41
60
40
60
39
Cuma 54
30
New Mountain
26
29
25
Solfa Terra
31
34
55
26
24
27
Gulf of PUZZOLE and BAIA
P. of Milenum
Nisida
21
22
23
47
36
Ischia
Procita
Italian Miles
1
3
5
2
4
6
12
Caprea I.


Capua
42
Caserta
60
60
60
60
60
60
PART OF THE APENNINES
E CAMPAGNA FELICE
44
45
46
59
10
9
M. Somma
M. Vesuvius
Herculaneum
NAPLES
Gulf of NAPLES
Pompeii
51
52
53
53
GULF OF
CASTEL A MARE
Plain of Sorrento
15
16
Point of Minerva
Gulf of SALERNO

Basire sc.

* * *

LETTER III.

To MATHEW MATY, M. D. Secretary to the Royal SOCIETY.

Villa Angelica, near Mount Veſuvius,
October 4, 1768.

SIR,

I HAVE but very lately received your laſt obliging letter, of the 5th of July, with the volume of Philoſophical Tranſactions.

I muſt beg of you to expreſs my ſatiſfaction at the notice which the Royal Society hath been pleaſed to take of my accounts of the two laſt eruptions of Mount Veſuvius. Since I have been at my villa here, I have enquired of the inhabitants of the mountain, after what they had ſeen during the laſt eruption. In my letter to Lord Morton, I mentioned nothing but what came immediately under my own obſervation: but as all the peaſants here agree in their account of the terrible thunder and lightning, which laſted almoſt the whole time of the eruption, upon the mountain only; I think it a circumſtance worth attending to. Beſides the lightning, which perfectly reſembled the common forked lightning, there were many meteors, like what are vulgarly called *falling ſtars.* A peaſant, in my neighbourhood, loſt eight hogs by the aſhes falling into the trough with their food: they grew giddy, and died in a few hours. The laſt day of the eruption, the aſhes, which fell abundantly upon the mountain, were as white almoſt as ſnow [*o*]; and the old people here aſſure me; that is a ſure ſymptom of the eruption being at an end. Theſe circumſtances, being well atteſted, I thought worth relating.

[*o*] In ſome accounts of an eruption of Veſuvius in 1660, I find mention made of aſhes which fell in the ſhape of croſſes, and were looked upon as highly miraculous; but in one book upon this ſubject, intituled, *Athanaſii Kircheri Soc. Jeſ. De prodigioſis crucibus, &c. Romæ*, MDCLXI, a very philoſophical account is given of this phænomenon; he ſays, that, in 1660, from the 16th of Auguſt to the 15th of October, Veſuvius caſt up aſhes, impregnated with nitrous, ſaline, and bitume,

It would require many years cloſe application, to give a proper and truly philoſophical account of the Volcanos in the neighbourhood of Naples; but I am ſure ſuch a hiſtory might be given, ſupported by demonſtration, as would deſtroy every ſyſtem hitherto given upon this ſubject. We have here an opportunity of ſeeing Volcanos in all their ſtates. I have been this ſummer in the iſland of Iſchia; it is about eighteen miles round, and its whole baſis is lava. The great mountain in it, near as high as Veſuvius, formerly called Epomeus, and now San Nicolo, I am convinced,

minous ſulphur, which upon linen garments took the form of croſſes, probably directed by the croſs-threads in the linen, and therefore that the ſalts did not ſhoot into ſuch a ſhape when they fell upon garments of woolen; a very particular deſcription of theſe croſſes may be found in page 38, of the abovementioned book.

vinced, was thrown up by degrees; and I have no doubt in my own mind, but that the iſland itſelf roſe out of the ſea in the ſame manner as ſome of the Azores. I am of the ſame opinion with reſpect to Mount Veſuvius, and all the high grounds near Naples; as having not yet ſeen, in any one place, what can be called virgin earth. I had the pleaſure of ſeeing a well ſunk, a few days ago, near my villa, which is, as you know, at the foot of Veſuvius, and cloſe by the ſea-ſide. At twenty-five feet below the level of the ſea, they came to a ſtratum of lava, and God knows how much deeper they might have ſtill found other lavas. The ſoil all round the mountain, which is ſo fertile, conſiſts of ſtratas of lavas, aſhes, pumice, and now-and-then a thin ſtratum of good earth, which good earth is produced by the ſurface mouldering, and the rotting of the roots of plants, vines, &c. This is plainly to be ſeen at Pompeii, where they are now digging into the ruins of that ancient city; the houſes are covered about ten or fifteen feet, with pumice and fragments of lava, ſome of which weigh three pounds (which laſt circumſtance I mention, to ſhew, that, in a great eruption, Veſuvius has thrown ſtones of this weight ſix miles [p], which is its diſtance from Pompeii, in a direct line); upon this ſtratum of pumice, or *rapilli*, as they call them here, is a ſtratum of excellent mould, about two feet thick, on which grow large trees, and excellent grapes. We have then the Solfaterra, which was certainly a Volcano, and has ceaſed erupting, for want of metallic particles, and over-abounding with ſulphur. You may trace its lavas into the ſea. We have the Lago d'Averno and the Lago d'Agnano, both of which were formerly Volcanos; and Aſtroni, which ſtill retains its form more than any of theſe. Its crater is walled round, and his Sicilian Majeſty takes the diverſion of boar-hunting in this Volcano; and neither his Majeſty, nor any one of his Court, ever dreamt of its former ſtate. We have then that curious mountain, called Montagno Nuovo, near Puzzole, which roſe, in one night, out of the Lucrine Lake; it is about a hundred and fifty feet high and three miles round. I do not think it more extraordinary, that Mount Veſuvius, in many ages, ſhould riſe above two thouſand feet; when this mountain, as is well atteſted, roſe in one night, no longer ago than the year 1538. I have a project, next ſpring, of paſſing ſome days at Puzzole, and of diſſecting this mountain, taking its meaſures, and making drawings of its ſtratas; for, I perceive, it is compoſed of ſtratas, like Mount Veſuvius, but without lavas. As this mountain is ſo undoubtedly formed intirely from a plain, I ſhould think my project may give light into the formation of many other mountains, that are at preſent thought to have been original, and are certainly not ſo, if their ſtrata correſpond with thoſe of the Montagno Nuovo. I ſhould be glad to know whether you think this project of mine will be uſeful; and, if you do, the reſult of my obſervations may be the ſubject of another letter [q].

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[p] I have ſince found in this ſtratum of erupted matter at Pompeii, ſtones weighing eight pounds; but many accounts of the great eruption of Veſuvius, particularly that of Antonio Buliſon, mention that a ſtone like a bomb was thrown from the crater of Veſuvius in 1631, and fell upon the Marquis of Lauro's houſe at Nola, which it ſet on fire. As Nola is twelve miles from Veſuvius, this circumſtance ſeems rather extraordinary: however, I have ſeen ſtones of an enormous ſize ſhot up to a very great height by Mount Veſuvius. In May 1771, having a ſtop watch in my hand, I obſerved that one of theſe ſtones was eleven ſeconds falling from its greateſt height, into the crater from whence it had been ejected. In 1767, a ſolid ſtone, meaſuring twelve feet in height, and forty-five in circumference, was thrown a quarter of a mile from the crater; the eruption of 1767, though by much the moſt violent of this century, was, comparatively to thoſe of the year 79 and 1631, very mild.

I cannot have a greater pleaſure than to employ my leiſure hours in what may be of ſome little uſe to mankind; and my lot has carried me into a country, which affords an ample field for obſervation. Upon the whole, if I was to eſtabliſh a ſyſtem, it would be, that *Mountains are produced by Volcanos, and not Volcanos by Mountains.*

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[q] See Letter V. in this collection.

I fear I have tired you: but the ſubject of Volcanos is ſo favourite a one with me, that it has led me on I know not how: I ſhall only add, that Veſuvius is quiet at preſent, though very hot at top, where there is a depoſition of boiling ſulphur. The lava that run in the Foſſa Grande during the laſt eruption, and is at leaſt two hundred feet thick, is not yet cool; a ſtick, put into its crevices, takes fire immediately. On the ſides of the crevices are fine cryſtalline ſalts: as they are the pure ſalts, which exhale from the lava that has no communication with the interiour of the mountain, they may perhaps indicate the compoſition of the lava.

I have done. Let me only thank you for the kind offers and expreſſions in your letter, and for the care you have had in ſetting-off my preſent to the Muſeum to the beſt advantage; of which I have been told from many quarters.

I am,

SIR,

Your moſt obedient

humble ſervant,

W. HAMILTON.

LETTER IV.

To MATHEW MATY, M. D. Secretary to the Royal SOCIETY.

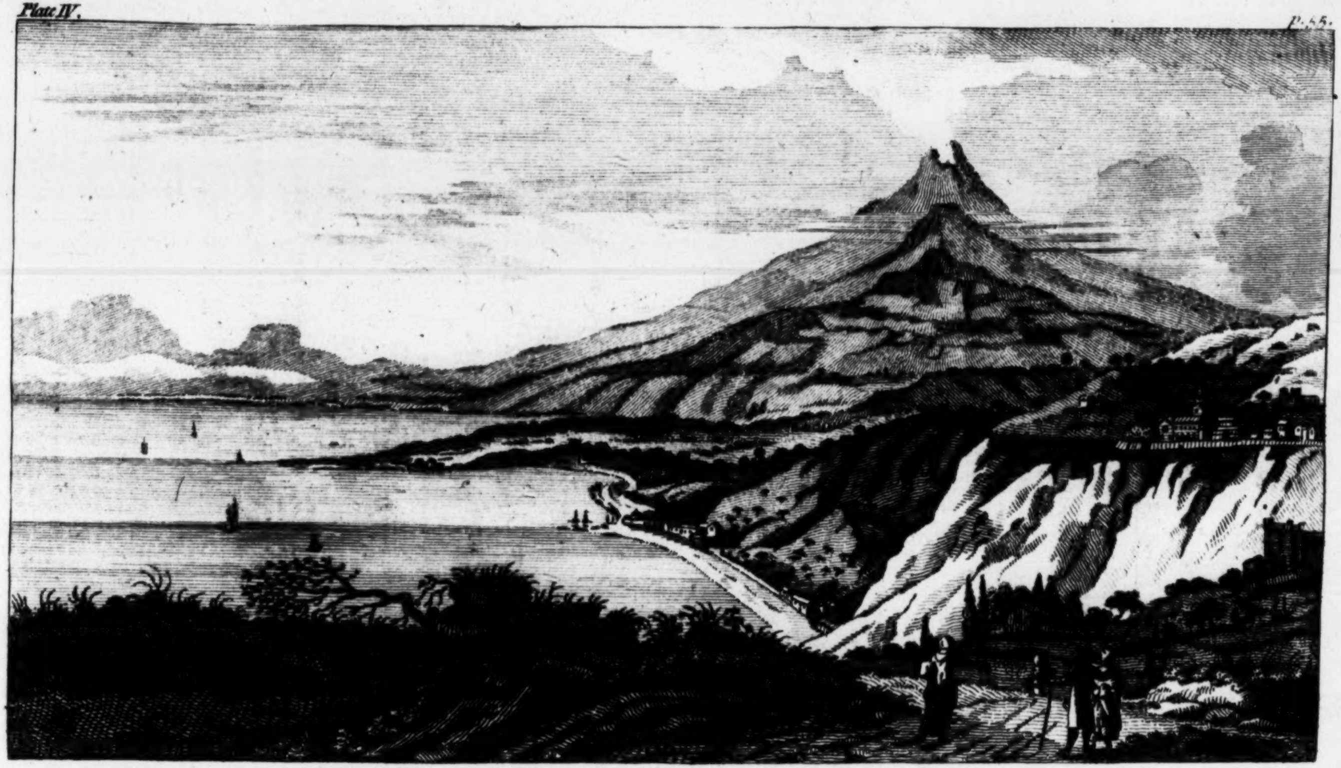
An Account of a Journey to MOUNT ETNA.

> " Artificis naturæ ingens opus aſpice, nulla
> " Tu tanta humanis rebus ſpectacula cernes."
>
> P. CORNELII SEVERI *Ætna*.

SIR, Naples, Oct. 17, 1769.

ENCOURAGED by the aſſurances you give me, in your laſt obliging letter of the 15th of June, that any new communication upon the ſubject of Volcano's would be received with ſatisfaction by the Royal Society; I venture to ſend you the following account of my late obſervations upon Mount Etna, which you are

Plate IV. P. 55.



A View of MOUNT ÆTNA from Taormina.

are at liberty to lay before our reſpectable Society, ſhould you think it worth its notice. [See Plate IV.]

After having examined with much attention the operations of Mount Veſuvius, during the five years that I have had the honour of reſiding as his Majeſty's Miniſter at this Court, and after having carefully remarked the nature of the ſoil for fifteen miles round this capital; I am, in my own mind, well convinced that the whole of it has been formed by exploſion. Many of the craters, from whence this matter has iſſued, are ſtill viſible; ſuch as the Solfaterra near Puzzole, the lake of Agnano, and near this lake a mountain compoſed of burnt matter, that has a very large crater ſurrounded with a wall, to incloſe the wild boars and deer, that are kept there for the diverſion of his Sicilian Majeſty; it is called Aſtruni: the Monte Nuovo, thrown up from the bottom of the Lucrine lake [r] in the year 1538, which has likewiſe its crater, and the lake of Averno. The iſlands of Niſida and Procida are entirely compoſed of burnt matter; the iſland of Iſchia is likewiſe compoſed of lava, pumice, and burnt matter; and there are in that iſland ſeveral viſible craters, from one of which, no longer ago than the year 1303, there iſſued a lava which ran into the ſea, and is ſtill in the ſame barren ſtate as the modern lavas of Veſuvius. After having, I ſay, been accuſtomed to theſe obſervations, I was well prepared to viſit the moſt ancient, and perhaps the moſt conſiderable Volcano that exiſts; and I had the ſatisfaction of being thoroughly convinced there, of the formation of very conſiderable mountains by meer exploſion, having ſeen many ſuch on the ſides of Etna, as will be related hereafter.

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[r] It is the common received opinion, that this mountain roſe from the bottom of the Lucrine lake. I

had not ſeen the very curious and particular account of its formation (which account is in my next letter) when I wrote this, and was therefore in the ſame error.

On the 24th of June laſt, in the afternoon, I left Catania, a town ſituated at the foot of Mount Etna, or, as it is now called, Mon-Gibello, in company with Lord Fortroſe and the Canonico Recupero, an ingenious prieſt of Catania, who is the only perſon there that is acquainted with the mountain: he is actually employed in writing its natural hiſtory; but, I fear, will not be able to compaſs ſo great and uſeful an undertaking, for want of proper encouragement.

We paſſed through the inferior diſtrict of the mountain called by its inhabitants La Regione Piemonteſe. It is well watered, exceedingly fertile, and abounding with vines, and other fruit trees, where the lava, or, as it is called there, the *ſciara*, has had time to ſoften, and gather ſoil ſufficient for vegetation, which, I am convinced from many obſervations, unleſs aſſiſted by art, does not come to paſs for many ages [*s*], perhaps a thouſand years or more; the circuit of this lower region, forming the baſis of the great Volcano, is upwards of one hundred Italian miles. The vines of Etna are kept low, quite the reverſe of thoſe on the borders of Veſuvius; and they produce a ſtronger wine, but not in ſo great abundance. The Piemonteſe diſtrict is covered with towns, villages, monaſteries, &c. and is well peopled, notwithſtanding the danger of ſuch a ſituation. Catania, ſo often deſtroyed by eruptions of Etna, and totally overthrown by an earthquake towards the end

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[*s*] This muſt depend greatly upon the quality of the lava's; ſome have been in a more perfect ſtate of vitri-

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fication than others, and are conſequently leſs liable to the impreſſions of time. I have often obſerved on Mount Veſuvius, when I have been cloſe to the mouth from whence a lava was diſgorging itſelf, that the quality of it varied greatly from time to time; I have ſeen it as fluid and coherent as glaſs when in fuſion; and I have ſeen it farinacious, the particles ſeparating as they forced their way out, juſt like meal coming from under the grindſtones. A ſtream of lava of this ſort, being leſs compact, and containing more earthy particles, would certainly be much ſooner fit for vegetation, than one compoſed of the more perfect vitrified matter.

of the laſt century [r], has been re-built within theſe fifty years, and is now a conſiderable town, with at leaſt thirty-five thouſand inhabitants. I do not wonder at the ſeeming ſecurity with which theſe parts are inhabited, having been ſo long witneſs to the ſame near Mount Veſuvius. The operations of Nature are ſlow: great eruptions do not frequently happen; each flatters himſelf it will not happen in his time, or, if it ſhould, that his tutelar faint will turn away the deſtructive lava from his grounds; and indeed the great fertility in the neighbourhoods of Volcanos tempts people to inhabit them.

In about four hours of gradual aſcent, we arrived at a little convent of Benedictine monks, called St. Nicolo dell' Arena, about thirteen miles from Catania,

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[r] This earthquake happened in the year 1693, and deſtroyed forty-nine towns and villages, nine hundred and twenty-two churches, colleges, and convents; and near one hundred thouſand perſons were buried in their ruin.

nia, and within a mile of the Volcano from whence iſſued the laſt very great eruption in the year 1669, a circumſtantial account of which was ſent to our court by a Lord Winchelſea, who happened to be then at Catania in his way home, from his embaſſy at Conſtantinople. His Lordſhip's account is curious, and was printed in London ſoon after; I ſaw a copy of it at Palermo, in the library of the Prince Torremuzzo [u]. We ſlept

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[u] It is intituled, "A true and exact relation of the "late prodigious earthquake and eruption of Mount "Ætna, or Monte Gibello; as it came in a letter writ- "ten to his Majeſty from Naples, by the Right Ho- "nourable the Earl of Winchelſea, his Majeſty's late "Embaſſador at Conſtantinople, who, in his return "from thence, viſiting Catania in the iſland of Sicily, "was an eye-witneſs of that dreadful ſpectacle; toge- "ther with a more particular narrative of the ſame, as "it is collected out of the ſeveral relations ſent from "Catania; publiſhed by authority. Printed by T. "Newcomb, in the Savoy, 1669."

"I accepted, ſays the author, p. 38, the invitation "of the Biſhop of Catania, to ſtay a day with him, that "ſo I might be the better able to inform your Majeſty in the Benedictines convent the night of

“ of that extraordinary fire, which comes from Mount
“ Gibel, fifteen miles diſtant from that city, which, for
“ its horridneſs in the aſpect, for the vaſt quantity there-
“ of (for it is fifteen miles in length, and ſeven in
“ breadth), for its monſtrous devaſtation and quick
“ progreſs, may be termed an inundation of fire, a
“ flood of fire, cinders, and burning ſtones, burning
“ with that rage as to advance into the ſea ſix hundred
“ yards, and that to a mile in breadth, which I ſaw;
“ and that which did augment my admiration was, to
“ ſee in the ſea this matter like ragged rocks, burning
“ in four fathom water, two fathom higher than the
“ ſea itſelf, ſome parts liquid, and throwing off, not
“ with great violence, the ſtones about it, which like a
“ cruſt of a vaſt bigneſs, and red hot, fell into the ſea
“ every moment, in ſome place or other, cauſing a great
“ and horrible noiſe, ſmoak, and hiſſing in the ſea;
“ and that more and more coming after it, making a
“ firm foundation in the ſea itſelf. I ſtayed there from
“ nine a clock on Saturday morning, to ſeven next
“ morning;” (this muſt have been towards the middle
or latter end of April;) “ and this mountain of fire
“ and ſtones with cinders, had advanced into the ſea
“ twenty yards at leaſt, in ſeveral places; in the mid-
“ dle of this fire, which burnt in the ſea, it hath form-
“ ed like to a river, with its banks on each ſide very
“ ſteep and craggy; and in this channel moves the
“ greateſt quantity of this fire, which is the moſt liquid,

the 24th, and paſſed the next morning in

“ with ſtones of the ſame compoſition, and cinders all red hot, ſwimming upon the fire of a great magnitude; from this river of fire doth proceed under the great maſs of the ſtones, which are generally three fathoms high all over the country, where it burns, and in other places much more. There are ſecret conduits or rivulets of this liquid matter, which communicates fire and heat into all parts more or leſs, and melts the ſtones and cinders by fits in thoſe places where it toucheth them, over and over again; where it meets with rocks or houſes of the ſame matter (as many are), they melt and go away with the fire; where they find other compoſitions, they turn them to lime or aſhes (as I am informed). The compoſition of this fire, ſtones and cinders, are ſulphur, nitre, quickſilver, ſal ammoniac, lead, iron, braſs, and all other metals. It moves not regularly, nor conſtantly down hill *; in ſome places it hath made the

* Having heard the ſame remark with reſpect to the lava's of Veſuvius, I determined, during an eruption of that Volcano, to watch the progreſs of a current of lava, and I was ſoon enabled to comprehend this ſeeming phænomenon; though it is, I fear, very difficult to explain. Certain it is, that the lava's, whilſt in their moſt fluid ſtate, follow always the law of other fluids; but when at a great diſtance from their ſource, and conſequently incumbered with ſcoriæ and cinders, the air likewiſe having rendered their outward coat tough, they will ſometimes

obſerving the ravage made by the above-

“ vallies hills, and the hills that are not high are now “ vallies. When it was night, I went upon two “ towers, in divers places; and could plainly ſee at ten “ miles diſtance, as we judged, the fire to begin to run “ from the mountain in a direct line, the flame to aſcend “ as high and as big as one of the greateſt ſteeples in “ your Majeſty's kingdoms, and to throw up great ſtones “ into the air; I could diſcern the river of fire to de-“ ſcend the mountain of a terrible fiery or red colour, “ and ſtones of a paler red to ſwim thereon, and to be “ ſome as big as an ordinary table. We could ſee this “ fire to move in ſeveral other places, and all the country “ covered with fire, aſcending with great flames †, in

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(as I have ſeen) be forced up a ſhort aſcent, the freſh matter puſhing forward that which went before it, and the exterior parts of the lava acting always as conductors (or pipes, if I may be allowed the expreſſion), for the interior parts, that have retained their fluidity by not having been expoſed to the air.

† The flames Lord Winchelſea mentions, were certainly produced by the lava having met with trees in its way; or perhaps his Lordſhip may have miſtaken the white ſmoak which conſtantly riſes from a lava (and in the night is tinged by the reflection of the red hot matter), for flame, of which indeed it has greatly the appearance at a diſtance. I have obſerved upon Mount Veſuvius, that, ſoon after a lava has borne down and burned a tree, a bright flame iſſues from its ſurface; otherwiſe I have never ſeen any flame attending an eruption.

mentioned terrible eruption, over the rich country of the Piemonteſe. The lava burſt out of a vineyard within a mile of

"many places, ſmoaking like to a violent furnace of "iron melted, making a noiſe with the great pieces "that fell, eſpecially thoſe which fell into the ſea. A "Cavalier of Malta, who lives there, and attended me, "told me, that the river was as liquid where it iſſues "out of the mountain, as water, and came out like a "torrent with great violence, and is five or ſix fathom "deep, and as broad, and that no ſtones ſink therein. "I aſſure your Majeſty, no pen can expreſs how terrible it is, nor can all the art and induſtry of the world "quench or divert that which is burning in the country. In forty days time, it hath deſtroyed the habitations of 27,000 perſons; made two hills of one, "1000 paces high apiece, and one is four miles in "compaſs; of 20,000 perſons, which inhabit Catania, "3000 did only remain; all their goods are carried "away, the cannons of braſs are removed out of the "caſtle, ſome great bells taken down, the city-gates "walled up next the fire, and preparations made to "abandon the city.

"That night which I lay there, it rained aſhes all "over the city, and ten miles at ſea it troubled my eyes. "This fire in its progreſs met with a lake of four "miles in compaſs; and it was not only ſatisfied to fill "it up, though it was four fathom deep, but hath "made of it a mountain."

St. Nicolò, and by frequent exploſions of ſtones and aſhes, raiſed there a mountain, which, as near as I can judge, having aſcending it, is not leſs than half a mile perpendicular in height, and is certainly at leaſt three miles in circumference at its baſis. The lava that ran from it, and on which there are as yet no ſigns of vegetation, is fourteen miles in length, and in many parts ſix in breadth; it reached Catania, and deſtroyed part of its walls, buried an amphitheatre, an aqueduct, and many other monuments of its ancient grandeur, which, till then, had reſiſted the hand of Time; and ran a conſiderable length into the ſea, ſo as to have once formed a beautiful and ſafe harbour; but it was ſoon after filled up by a freſh torrent of the ſame inflamed matter: a circumſtance the Catanians lament to this day, as they are without a port. There has been no ſuch eruption ſince, though there are ſigns of many, more terrible, that have preceded it.

For two or three miles round the mountain raiſed by this eruption, all is barren, and covered with aſhes; this ground, as well as the mountain itſelf, will in time certainly be as fertile as many other mountains in its neighbourhood, that have been likewiſe formed by exploſion. If the dates of theſe exploſions could be aſcertained, it would be very curious, and mark the progreſs of time with reſpect to the return of vegetation, as the mountains raiſed by them are in different ſtates; thoſe (which I imagine to be the moſt modern) are covered with aſhes only; others of an older date, with ſmall plants and herbs; and the moſt antient, with the largeſt timber-trees I ever ſaw; but I believe the latter are ſo very ancient, as to be far out of the reach of hiſtory. At the foot of the mountain, raiſed by the eruption of the year 1669, there is a hole, through which, by means of a rope, we deſcended into ſeveral ſubterraneous caverns, branching out and extending much farther and deeper than we choſe to venture, the cold there being exceſſive, and a violent wind frequently extinguiſhing ſome of our torches. Theſe caverns undoubtedly contained the lava that iſſued forth and extended, as I ſaid before, quite to Catania. There are many of theſe ſubterraneous cavities known, on other parts of Etna; ſuch as that, called by the peaſants, La Baracca Vecchia, another La Spelonca della Palomba (from the wild pigeons building their neſts therein), and the cavern Thalia, mentioned by Boccaccio. Some of them are made uſe of as magazines for ſnow; the whole iſland of Sicily and Malta being ſupplied with this eſſential article (in a hot climate) from Mount Etna. Many more would be found, I dare ſay, if ſearched for, particularly near and under the craters from whence great lavas have iſſued, as the immenſe quantities of ſuch matter we ſee above ground muſt neceſſarily ſuppoſe very great hollows underneath.

After having paſſed the morning of the 25th in theſe obſervations, we proceeded through the ſecond or middle region of Etna, called La Selvoſa, *the woody*, than which nothing can be more beautiful. On every ſide are mountains, or fragments of mountains, that have been thrown up by various ancient exploſions; there are ſome near as high as Mount Veſuvius; one in particular (as the Canon our guide aſſured me, having meaſured it) is little leſs than one mile in perpendicular height, and five in circumference at its baſis. They are all more or leſs covered, even within their craters, as well as the rich vallies between them, with the largeſt oak, cheſnut, and fir trees, I ever ſaw any where; and indeed it is from hence chiefly, that his Sicilian Majeſty's dock-yards are ſupplied with timber. As this part of Etna was famous for its timber in the time of the Tyrants of Syracuſa, and as it requires the great length of time I have already mentioned before the matter is fit for vegetation, we may conceive the great age of this reſpectable Volcano. The cheſnut-trees predominated in the parts through which we paſſed, and, though of a very great ſize, are not to be compared to ſome on another part of the Regione Selvoſa, called Carpinetto. I have been told by many, and particularly by our guide, who had meaſured the largeſt there, called La Caſtagna di Cento Cavalli,* that it is upwards of twenty-eight Neapolitan canes in circumference. Now as a Neapolitan cane is two yards and half a quarter, Engliſh meaſure, you may judge, Sir, of the immenſe ſize of this famous tree [x]. It is hollow from age, but there is another near it almoſt as large and ſound. As it would have required a journey of two days to have viſited this extraor-

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[x] I have heard ſince, from ſome of our countrymen who have meaſured this tree, that its dimenſions are actually as abovementioned; but that they could perceive ſome ſigns of four ſtems having grown together, and formed one tree.

* Circumference 178 ft. : 6 inches
Diameter — — 59 ft. : 6 inch.

dinary tree, and the weather being already very hot, I did not ſee it. It is amazing to me, that trees ſhould flouriſh in ſo ſhallow a ſoil; for they cannot penetrate deep without meeting with a rock of lava; and indeed great part of the roots of the large trees we paſſed by are above ground, and have acquired, by the impreſſion of the air, a bark like that of their branches. In this part of the mountain, are the fineſt horned cattle in Sicily; we remarked in general, that the horns of the Sicilian cattle are near twice the ſize of any we had ever ſeen; the cattle themſelves are of the common ſize. We paſſed by the lava of the laſt eruption in the year 1766, which has deſtroyed above four miles ſquare of the beautiful wood abovementioned. The mountain raiſed by this eruption abounds with ſulphur and ſalts, exactly reſembling thoſe of Veſuvius; ſpecimens of which I ſent ſome time ago to the late Lord Morton.

In about five hours from the time we had left the convent of St. Nicolo dell

Arena, we arrived at the borders of the third region, called La Netta, or Scoperta, *clean* or *uncovered*, where we found a very ſharp air indeed; ſo that in the ſame day, the four ſeaſons of the year were ſenſibly felt by us, on this mountain; exceſſive ſummer heats in the Piemonteſe, ſpring and autumn temperature in the middle, and extreme cold of winter in the upper region. I could perceive, as we approached the latter, a gradual decreaſe of vegetation, and from large timber trees we came to the ſmall ſhrubs and plants of the northern climates: I obſerved quantities of juniper and tanzey; our guide told us, that later in the ſeaſon there are numberleſs curious plants here, and that in ſome parts there are rhubarb and ſaffron in plenty. In Carrera's Hiſtory of Catania, there is a liſt of all the plants and herbs of Etna, in alphabetical order.

Night coming on, we here pitched a tent and made a good fire, which was very neceſſary; for without it, and very warm cloathing, we ſhould ſurely have periſhed with cold; and at one of the clock in the morning of the 26th, we purſued our journey towards the great crater. We paſſed over vallies of ſnow, that never melts, except there is an eruption of lava from the upper crater, which ſcarcely ever happens; the great eruptions are uſually from the middle region, the inflamed matter finding (as I ſuppoſe) its paſſage through ſome weak part, long before it can riſe to the exceſſive height of the upper region, the great mouth on the ſummit only ſerving as a common chimney to the Volcano. In many places the ſnow is covered with a bed of aſhes, thrown out of the crater, and the ſun melting it in ſome parts makes this ground treacherous; but as we had with us, beſides our guide, a peaſant well accuſtomed to theſe vallies, we arrived ſafe at the foot of the little mountain of aſhes that crowns Etna, about an hour before the riſing of the ſun. This mountain is ſituated in a gently inclining plain, of about nine miles in circumference; it is about a quarter of a mile perpendicular in height, very ſteep, but not quite ſo ſteep as Veſuvius; it has been thrown up within theſe twenty-five or thirty years, as many people at Catania have told me they remembered when there was only a large chaſm or crater, in the midſt of the abovementioned plain. Till now the aſcent had been ſo gradual (for the top of Etna is not leſs than thirty miles from Catania, from whence the aſcent begins) as not to have been the leaſt fatiguing; and if it had not been for the ſnow, we might have rode upon our mules to the very foot of the little mountain, higher than which the Canon our guide had never been: but as I ſaw that this little mountain was compoſed in the ſame manner as the top of Veſuvius, which, notwithſtanding the ſmoak iſſuing from every pore, is ſolid and firm, I made no ſcruple of going up to the edge of the crater, and my companions followed. The ſteep aſcent, the keenneſs of the air, the vapours of the ſulphur, and the violence of the wind, which obliged us ſeveral times to throw ourſelves flat upon our faces to avoid being over-turned by it, made this latter part of our expedition rather inconvenient and diſagreeable. Our guide, by way of comfort, aſſured us that there was generally much more wind in the upper region at this time.

Soon after we had ſeated ourſelves on the higheſt point of Etna, the ſun aroſe, and diſplayed a ſcene that indeed paſſes all deſcription. The horizon lighting up by degrees, we diſcovered the greateſt part of Calabria, and the ſea on the other ſide of it; the Phare of Meſſina, the Lipari Iſlands; Stromboli, with its ſmoaking top, though at above ſeventy miles diſtance, ſeemed to be juſt under our feet; we ſaw the whole iſland of Sicily, its rivers, towns, harbours, &c. as if we had been looking on a map. The iſland of Malta is low ground, and there was a hazineſs in that part of the horizon, ſo that we could not diſcern it; our guide aſſured us, he had ſeen it diſtinctly at other times, which I can believe, as in other parts of the horizon, that were not hazy, we ſaw to a much greater diſtance; beſides, we had a clear view of Etna's top from our ſhip as we were going into the mouth of the harbour of Malta ſome weeks before; in ſhort, as I have ſince meaſured on a good chart, we took in at one view a circle of above nine hundred Engliſh miles. The pyramidal ſhadow of the mountain reached acroſs the whole iſland, and far into the ſea on the other ſide. I counted from hence forty-four little mountains (little I call them in compariſon of their mother Etna, though they would appear great any where elſe) in the middle region on the Catania ſide, and many others on the other ſide of the mountain, all of a conical form, and each having its crater; many with timber trees flouriſhing both within and without their craters.

The points of thoſe mountains, that I imagine to be the moſt ancient, are blunted, and the craters of courſe more extenſive and leſs deep than thoſe of the mountains formed by exploſions of a later date, and which preſerve their pyramidal form entire. Some have been ſo far mouldered down by time, as to have no other appearance of a crater than a ſort of dimple or hollow on their rounded tops, others with only half or a third part of their cone ſtanding; the parts that are wanting having mouldered down, or perhaps been detached from them by earthquakes, which are here very frequent. All however have been evidently raiſed by exploſion; and I believe, upon examination, many of the whimſical ſhapes of mountains in other parts of the world would prove to have been occaſioned by the ſame natural operations. I obſerved that theſe mountains were generally in lines or ridges; they have moſtly a fracture on one ſide, the ſame as in the little mountains raiſed by exploſion on the ſides of Veſuvius, of which there are eight or nine. This fracture is occaſioned by the lava's forcing its way out, which operation I have deſcribed in my account of the laſt eruption of Veſuvius. Whenever I ſhall meet with a mountain, in any part of the world, whoſe form is regularly conical, with a hollow crater on its top, and one ſide broken, I ſhall be apt to decide ſuch a mountain's having been formed by an eruption; as both on Etna and Veſuvius the mountains formed by exploſion are without exception according to this deſcription. But to return to my narrative.

After having feaſted our eyes with the glorious proſpect above-mentioned (for which, as Spartian tells us, the Emperor Adrian was at the trouble of aſcending Etna), we looked into the great crater, which, as near as we could judge, is about two miles and a half in circumference; we did not think it ſafe to go round and meaſure it, as ſome parts ſeemed to be very tender ground. The inſide of the crater, which is incruſted with ſalts and ſulphurs like that of Veſuvius, is in the form of an inverted hollow cone, and its depth nearly anſwers to the height of the little mountain that crowns the great Volcano. The ſmoak, iſſuing abundantly from the ſides and bottom, prevented our ſeeing quite down; but the wind clearing away the ſmoak from time to time, I ſaw this inverted cone contracted almoſt to a point; and, from repeated obſervations, I dare ſay, that in all Volcanos, the depth of the craters will be found to correſpond nearly to the height of the conical mountains of cinders which uſually crown them: in ſhort, I look upon the craters as a ſort of ſuſpended funnels, under which are vaſt caverns and abyſſes. The formation of ſuch conical mountains with their craters are eaſily accounted for, by the fall of the ſtones, cinders, and aſhes, emitted at the time of an eruption.

The ſmoak of Etna, though very ſulphureous, did not appear to me ſo fetid and diſagreeable as that of Veſuvius; but our guide told me that its quality varies, as I know that of Veſuvius does, according to the quality of the matter then in motion within. The air was ſo very pure and keen in the whole upper region of Etna, and particularly in the moſt elevated parts of it, that we had a difficulty in reſpiration, and that, independent of the ſulphureous vapour. I brought two barometers and a thermometer with me from Naples, intending to have left one with a perſon at the foot of the mountain, whilſt we made our obſervations with the other, at ſun riſing, on the ſummit; but one barometer was unluckily ſpoilt at ſea, and I could find no one expert enough at Catania to repair it: what is extraordinary, I do not recollect having ſeen a barometer in any part of Sicily. At the foot of Etna, the 24th, when we made our firſt obſervation, the quickſilver ſtood at 27 degrees 4 lines; and the 26th, at the moſt elevated point of the volcano, it was at 18 degrees 10 lines. The thermometer, on the firſt obſervation at the foot of the mountain was at 84 degrees, and on the ſecond at the crater at 56 [*y*]. The weather had not changed in any reſpect, and was equally fine and clear, the 24th and 26th. We found it difficult to manage our barometer in the extreme cold and high wind on the top of Etna; but from the moſt exact obſervations we could make, in our circumſtances, the reſult was as abovementioned. The Canon aſſured me, that the perpendicular height of Mount Etna is ſomething more than three Italian miles, and I verily believe it is ſo.

[*y*] No great ſtreſs ſhould be laid upon theſe obſervations, as the many inconveniences we laboured under, and the little practice we had in ſuch nice operations, muſt neceſſarily have rendered them very inaccurate. The Canon Recupero, who was our guide, attended Meſſ. Glover, Fullerton, and Brydone, up Mount Etna in June 1770. The latter is a very ingenious and accurate obſerver, and has taken the height of many of the higheſt mountains in the Alps. His obſervations, as the Canon informed me, were as follows: At the top of the mountain, the quickſilver in the thermometer was 9 degrees below freezing point, when, at the foot of the mountain, it roſe to 76. At the foot of the little mountain, that crowns the Volcano, the barometer ſtood at $20^\circ\ 4\frac{2}{3}'$, half way up this little mountain, it was at $19^\circ\ 6'$; but the wind was too violent for them to attempt any more obſervations. The barometer and thermometer were of Fahrenheit's. Mr. Brydone remarked as he went up in the night, that he could diſtinguiſh the ſtars in the milky way with won-

After having paſſed at leaſt three hours on the crater, we deſcended and went to a riſing ground, about a mile diſtant from the upper mountain we had juſt left, and ſaw there ſome remains of the foundation of an ancient building; it is of brick, and ſeems to have been ornamented with white marble, many fragments of which are ſcattered about. It is called the Philoſopher's Tower, and is ſaid to have been

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derful clearneſs, and that the cold was much more intenſe than he had ever felt upon the higheſt mountains of the Alps.

inhabited by Empedocles. As the ancients uſed to ſacrifice to the celeſtial gods on the top of Etna [z], it may very well be the ruin of a temple that ſerved for that purpoſe. From hence we went a little further over the inclined plain abovementioned, and ſaw the evident marks of a dreadful torrent of hot water, that came out of the great crater at the time of an eruption of lava in the year 1755, and upon which phænomenon the Canonico Recupero, our guide, has publiſhed a diſſertation. Luckily this torrent did not take its courſe over the inhabited parts of the mountain; as a like accident on Mount Veſuvius in 1631 ſwept away ſome towns and villages in its neighbourhood, with thouſands of their inhabitants. The common received opinion is, that theſe eruptions of water proceed from the Volcanos having a communication with the ſea; but I rather believe them to proceed merely from depoſitions of rain water in ſome of the inward cavities of them. We likewiſe ſaw from hence the whole courſe of an ancient lava, the moſt conſiderable as to its extent of any known here; it ran into the ſea near Taormina, which is not leſs than thirty miles from the crater whence it iſſued, and is in many parts fifteen miles in breadth. As the lavas of Etna are very commonly fifteen and twenty miles in length, ſix or ſeven in breadth, and fifty feet or more in depth; you may judge, Sir, of the prodigious quantities of matter emitted in a great eruption of this mountain, and of the vaſt cavities there muſt neceſſarily be within its bowels. The moſt extenſive lavas of Veſuvius do not exceed ſeven miles in length; the operations of nature on the one mountain and the other are certainly the ſame;

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[z] This paſſage, in Cornelius Severus's poem upon Etna, ſeems to confirm my opinion:

"Placanteſque etiam cæleſtia numina thure
"Summo cerne jugo, vel quâ liberrimus Ætna
"Improſpectus hiat; tantarum ſemina rerum
"Si nihil irritet flammas, ſtupeatque profundum."

but

but on Mount Etna, all are upon a great ſcale. As to the nature and quality of their lavas, they are much the ſame; but I think thoſe of Etna rather blacker, and in general more porous, than thoſe of Veſuvius. In the parts of Etna that we went over, I ſaw no ſtratas of pumice ſtones, which are frequent near Veſuvius, and cover the ancient city of Pompeia; but our guide told us, that there are ſuch in other parts of the mountain. I ſaw ſome ſtratas of what is called here *tufa*, it is the ſame that covers Herculaneum, and that compoſes moſt of the high grounds about Naples; it is upon examination a mixture of ſmall pumice ſtones, aſhes, and fragments of lava, which is by time hardened into a ſort of ſtone [*a*]. In ſhort, I found, with reſpect to the matter erupted, nothing on Mount Etna that Veſuvius does not produce; and there certainly is a much greater variety in the erupted matter and lavas of the latter, than of the former; both abound with pyrites and cryſtallizations, or rather vitrifications. The ſea ſhore at the foot of Etna, indeed, abounds with amber, of which there is none found at the foot of Veſuvius. At preſent there is a much greater quantity of ſulphur and ſalts on the top of Veſuvius than on that of Etna; but this circumſtance varies according to the degree of fermentation within; and our guide aſſured me, he had ſeen greater quantities on Etna at other times. In our way back to Catania, the Canon ſhewed me a little hill, covered with vines, which belonged to the Jeſuits, and, as is well atteſted, was undermined by the lava in the year 1669, and tranſported half a mile from the place where it ſtood, without having damaged the vines.

[*a*] A better account of the formation of *tufa* will be ſeen in my next letter.

In great eruptions of Etna, the ſame ſort of lightening, as deſcribed in my account of the laſt eruption of Veſuvius, has been frequently ſeen to iſſue from the ſmoak of its great crater. The antients took notice of the ſame phænomenon; for Seneca (lib. ii. Nat. Quæſt.) ſays,—"Ætna aliquando multo igne abundavit, "ingentem vim arenæ urentis effudit, in"volutus eſt dies pulvere, populoſque "ſubita nox terruit, *illo tempore aiunt plu"rima fuiſſe tonitrua et fulmina.*"

Til the year 252 of Chriſt, the chronological accounts of the eruptions of Etna are very imperfect; but as the veil of St. Agatha was in that year firſt oppoſed to check the violence of the torrents of lava, and has ever ſince been produced at the time of great eruptions; the miracles attributed to its influence, having been carefully recorded by the prieſts, have at leaſt preſerved the dates of ſuch eruptions. The relicks of St. Januarius have rendered the ſame ſervice to the lovers of natural hiſtory, by recording the great eruptions of Veſuvius. I find, by the dates of the eruptions of Etna, that it is as irregular and uncertain in its operations as Veſuvius[b]. The laſt eruption was in 1766.

On our return from Meſſina to Naples, we were becalmed three days in the midſt of the Lipari iſlands, by which we had an opportunity of ſeeing that they have all been evidently formed by exploſion[c];

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[b] The dates of the eruptions of Mount Etna, recorded by hiſtory, are as follows: Before the Chriſtian æra four, in the years 3525. 3538. 3554. 3843. After Chriſt, twenty-ſeven have been recorded, 1175. 1285. 1321. 1323. 1329. 1408. 1530. 1536. 1537. 1540. 1545. 1554. 1556. 1566. 1579. 1614. 1634. 1636. 1643. 1669. 1682. 1689. 1692. 1702. 1747. 1755. 1766.

The dates of the eruptions of Veſuvius, are as follows: After Chriſt—79. 203. 472, 512. 685. 993. 1036. 1043. 1048. 1136. 1506. [1538, the eruption at Puzzole.] 1631, 1660. 1682. 1694, 1701. 1704. 1712. 1717. 1730. 1737. 1751. 1754. 1760. 1766. 1767. 1770. 1771.

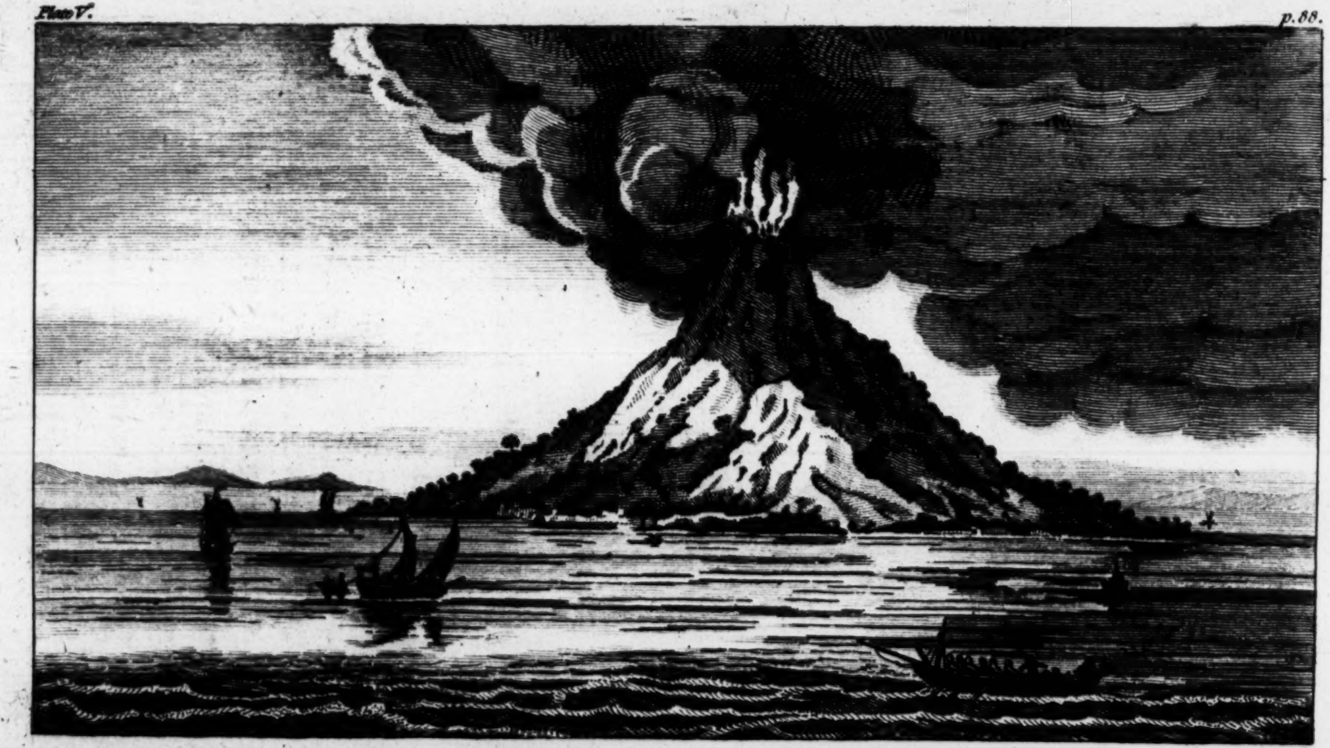
[c] Pliny, in his account of theſe iſlands, in the IX chapter of the third book of his Natural Hiſtory, ſeems to confirm this opinion.

"Lipara cum civium Romanorum oppido, dicta à "Liparo rege, qui ſucceſſit Æolo, antea Melogonis vel "Meliganis vocitata, abeſt XII millia paſſ. ab Italia, one of them, called Vulcano, is in the ſame ſtate as the Solfaterra. Stromboli is a Volcano, exiſting in all its force, and, in its form of courſe, is the moſt pyramidal of all the Lipari Iſlands; we ſaw it throw up red hot ſtones from its crater frequently, and ſome ſmall ſtreams of lava iſſued from its ſide, and ran into the ſea. This Volcano differs from Etna and Veſuvius, by its continually emitting fire, and ſeldom any lava; notwithſtanding its continual exploſions, this iſland is inhabited, on one ſide, by about an hundred families [d].

“ ipſa circuitu paulo minori. Inter hanc et Siciliam
“ altera, antea Theraſia appellata, nunc Hiera; qui
“ ſacra Vulcano eſt, colle in ea nocturnas evomente
“ flammas. Tertia Strongyle, a Lipara millia paſſuum
“ ad exortum ſolis vergens, in qua regnavit Æolus, quæ
“ à Lipara liquidiore flamma tantum differt: e cujus
“ fumo equinam flaturi ſint venti, in triduum prædicere
“ incolæ traduntur: unde ventos Æolo paruiſſe exiſ-
“ timatum. Quarta Didyme, minor quam Lipara.
“ Quinta Ericuſa; ſexta Phœnicuſa; pabulo proxi-
“ marum relicta. NOVISSIMA, eademque Minima,
“ Evonymos.”

[d] See Plate V.

Plate V. p. 88.



STROMBOLI; one of the LIPARI ISLANDS

Theſe, as well as I can recollect, are all the obſervations that I made with reſpect to Volcanos, in my late curious tour of Sicily; and I ſhall be very happy ſhould the communication of them afford you, or any of our countrymen (lovers of natural hiſtory), ſatisfaction or entertainment.

I am,

SIR,

With great regard and eſteem,

Your moſt obedient

humble ſervant,

W. HAMILTON.

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LETTER V.

To MATHEW MATY, M. D. Secretary to the Royal SOCIETY.

REMARKS upon the NATURE of the SOIL of NAPLES, and its Neighbourhood.

> " Mille miracula movet faciemque mutat locis, et de-
> " fert montes, ſubrigit plana, valles extuberat novas,
> " in profundo inſulas eregit."
>
> SENECA, De Terræ-motu.

SIR, Naples, Oct. 16, 1770.

ACCORDING to your deſire, I loſe no time in ſending you ſuch further remarks as I have been making with ſome diligence, for ſix years paſt, in the compaſs of twenty miles or more, round this capital. By accompanying theſe remarks with a map of the country I deſcribe [PLATE VI.], and with the ſpecimens of different matters that compoſe the moſt remarkable ſpots of it, I do not doubt but that I ſhall convince you, as I am myſelf convinced, that the whole circuit (ſo far as I have examined) within the boundaries marked in the map, is wholly and totally the production of ſubterraneous fires; and that moſt probably the ſea formerly reached the mountains that lie behind Capua and Caſerta, and are a continuation of the Appennines. If I may be allowed to compare ſmall things with great, I imagine the ſubterraneous fires to have worked in this country under the bottom of the ſea, as moles in a field, throwing up here and there a hillock; and that the matter thrown out of ſome of theſe hillocks, formed into ſettled Volcanos, filling up the ſpace between one and the other, has compoſed this part of the continent, and many of the iſlands adjoining.

From the obſervations I have made upon Mount Etna, Veſuvius, and its neighbourhood,

hood, I dare ſay, that, after a careful examination, moſt mountains that are, or have been Volcanos, would be found to owe their exiſtence to ſubterraneous fire; the direct reverſe of what I find the commonly received opinion.

Nature, though varied, is certainly in general uniform in her operations; and I cannot conceive that two ſuch conſiderable Volcanos as Etna and Veſuvius ſhould have been formed otherwiſe than every other conſiderable Volcano of the known world. I do not wonder that ſo little progreſs has been made in the improvement of natural hiſtory, and particularly in that branch of it which regards the theory of earth; Nature acts ſlowly, it is difficult to catch her in the fact. Thoſe who have made this ſubject their ſtudy have, without ſcruple, undertaken at once, to write the natural hiſtory of a whole province, or of an entire continent; not reflecting, that the longeſt life of man ſcarcely affords him time to give a perfect one of the ſmalleſt inſect.

I am ſenſible of what I undertake in giving you, Sir, even a very imperfect account of the nature of the ſoil of a little more than twenty miles round Naples: yet I flatter myſelf that my remarks, ſuch as they are, may be of ſome uſe to any one hereafter, who may have leiſure and inclination to follow them up. The kingdom of the Two Sicilies offers certainly the faireſt field for obſervations of this kind, of any in the whole world; here are Volcanos exiſting in their full force, ſome on their decline, and others totally extinct.

To begin with ſome degree of order, which is really difficult in the variety of matter that occurs to my mind, I will firſt mention the baſis on which I found all my conjectures. It is the nature of the ſoil that covers the antient towns of Herculaneum and Pompeii, and the interior and exterior form of the new mountain, near Puzzole, with the ſort of materials of which it is compoſed. It cannot be denied, that Herculaneum and Pompeii ſtood once above ground; though now, the former is in no part leſs than ſeventy feet, and in ſome parts one hundred and twelve feet below the preſent ſurface of the earth; and the latter is buried ten or twelve feet deep, more or leſs. As we know from the very accurate account given by Pliny the younger to Tacitus, and from the accounts of other contemporary authors, that theſe towns were buried by an eruption of Mount Veſuvius in the time of Titus; it muſt be allowed, that whatever matter lies between theſe cities and the preſent ſurface of the earth over them, muſt have been produced ſince the year 79 of the Chriſtian æra, the date of that formidable eruption.

Pompeii, which is ſituated at a much greater diſtance from the Volcano than Herculaneum, has felt the effects of a ſingle eruption only; it is covered with white pumice ſtones, mixed with fragments of lava and burnt matter, large and ſmall: the pumice is very light; but I have found ſome of the fragments of lava and cinders there, weighing eight pounds. I have often wondered, that ſuch weighty bodies could have been carried to ſuch a diſtance (for Pompeii cannot be leſs than five miles, in a ſtrait line, from the mouth of Veſuvius). Every obſervation confirms the fall of this horrid ſhower over the unfortunate city of Pompeii, and that few of its inhabitants had dared to venture out of their houſes; for in many of thoſe which have been already cleared, ſkeletons have been found, ſome with gold rings, ear rings, and bracelets. I have been preſent at the diſcovery of ſeveral human ſkeletons myſelf; and under a vaulted arch, about two years ago, at Pompeii, I ſaw the bones of a a man and a horſe taken up, with the fragments of the horſe's furniture, which had been ornamented with falſe gems ſet in bronze. The ſkulls of ſome of the ſkeletons found in the ſtreets had been evidently fractured by the fall of the ſtones. His Sicilian Majeſty's excavations are confined to this ſpot at preſent; and the curious in antiquity may expect hereafter, from ſo rich a mine, ample matter for their diſſertations: but I will confine myſelf to ſuch obſervations only as relate to my preſent ſubject.

Over the ſtratum of pumice and burnt matter that covers Pompeii, there is a ſtratum of good mould, of the thickneſs about two feet and more in ſome parts, in which vines flouriſh, except in ſome particular ſpots of this vineyard, where they are ſubject to be blaſted by a foul vapour, or *moſete*, as it is called here, that riſes from beneath the burnt matter. The abovementioned ſhower of pumice ſtones, according to my obſervations, extended beyond Caſtel-a-mare (near which ſpot the ancient town of Stabia alſo lies buried under them), and covered a tract of country not leſs than thirty miles in circumference.

It was at Stabia that Pliny the elder loſt his life, and this ſhower of pumice ſtones is well deſcribed in the younger Pliny's letter. Little of the matter that has iſſued from Veſuvius ſince that time, has reached theſe parts: but I muſt obſerve, that the pavement of the ſtreets of Pompeii is of lava; nay, under the foundation of the town, there is a deep ſtratum of lava and burnt matter. Theſe circumſtances, with many others that will be related hereafter, prove, beyond a doubt, that there have been eruptions of Veſuvius previous to that of the year 79, which is the firſt recorded by hiſtory.

The growth of ſoil by time is eaſily accounted for; and who, that has viſited ruins of ancient edifices, has not often ſeen a flouriſhing ſhrub, in a good ſoil, upon the top of an old wall? I have remarked many ſuch on the moſt conſiderable ruins at Rome and elſewhere. But from the ſoil which has grown over the barren pumice that covers Pompeii, I was enabled to make a curious obſervation. Upon examining the cuts and hollow ways made by currents of water in the neighbourhood of Veſuvius and of other Volcanos, I had remarked that there lay frequently a ſtratum of rich ſoil, of more or leſs depth, between the matter produced by the exploſion of ſucceeding eruptions [e]; and I was naturally led think to think, that ſuch a ſtratum had grown in the ſame manner as the one abovementioned over the pumice of Pompeii. Where the ſtratum of good ſoil was thick, it was evident to me that many years had elapſed between one eruption and that which ſucceeded it. I do not pretend to ſay, that a juſt eſtimate can be formed of the great age of Volcanos from this obſervation; but ſome ſort of calculation might be made: for inſtance, ſhould an explosion of pumice cover again the ſpot under which Pompeii is buried, the ſtratum of rich ſoil abovementioned would certainly lie between two beds of pumice; and if a like accident had happened a thouſand years ago, the ſtratum of rich ſoil would as certainly have wanted much of its preſent thickneſs, as the rotting of vegetables, manure, &c. is ever increaſing a cultivated ſoil. Whenever I find then a ſucceſſion of different ſtrata of pumice and burnt matter, like that which covers Pompeii, intermixed with ſtrata of rich ſoil, of greater or leſs depth, I hope I may be allowed reaſonably to conclude, that the whole has been the production of a long ſeries of eruptions, occaſioned by ſubterraneous fire. By the ſize and weight of the pumice, and fragments of burnt erupted matter in theſe ſtrata, it is eaſy to trace them up to their ſource, which I have done more than once in the neighbourhood of Puzzole, where exploſions have been frequent. The gradual decreaſe in the ſize and quantity of the erupted matter in the ſtratum above mentioned, from Pompeii to Caſtle-a-Mare, is very viſible: at Pompeii, as I ſaid before, I have found them of eight pounds weight, when at Caſtle-a-Mare the largeſt do not weigh an ounce.

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[e] The Abate Giulio Ceſare Bruccini deſcribes very elegantly, in his account of the eruption of Veſuvius in 1631, his having made an obſervation of the like nature—his words are (after having particularized the different ſtrata of erupted matter lying one over another)—"parendo appunto che la natura ci abbia voluto laſciare ſcritto in queſta terra tutti gli incendii memorabili raccontati delli autori."

The matter which covers the ancient town of Herculaneum is not the produce of one eruption only; for there are evident marks that the matter of ſix eruptions has taken its courſe over that which lies immediately above the town, and was the cauſe of its deſtruction. Theſe ſtrata are either of lava or burnt matter, with veins of good ſoil between them. The ſtratum of erupted matter that immediately covers the town, and with which the theatre and moſt of the houſes were filled, is not of that foul vitrified matter, called lava, but of a ſort of ſoft ſtone, compoſed of pumice, aſhes, and burnt matter. It is exactly of the ſame nature with what is called here the Naples ſtone; the Italians diſtinguiſh it by the name of *tufa*, and it is in general uſe for building. Its colour is uſually that of our free ſtone, but ſometimes tinged with grey, green, and yellow; and the pumice ſtones, with which it ever abounds, are ſometimes large, and ſometimes ſmall: it varies likewiſe in its degree of ſolidity.

The chief article in the compoſition of *tufa* ſeems to me to be, that fine burnt material, which is called *puzzolane*, whoſe binding quality and utility by way of cement are mentioned by Vitruvius [*f*], and

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[*f*] Theſe are his words, book II. chap. vi.

"De Pulvere Puteolano.

"Eſt etiam genus pulveris, quod efficit naturaliter res admirandas. Naſcitur in regionibus Baïanis, et in agris municipiorum, quæ ſunt circa Veſuvium montem, quod commixtum cum calce, et cæmento non modo cæteris ædificiis præſtat firmitates, ſed etiam moles, quæ conſtruuntur in mari, ſub aqua ſolideſcunt. Hoc autem fieri hac ratione videtur, quod ſub his montibus et terra ferventes ſunt fontes crebri, qui non eſſent, ſi non in imo haberent, aut de ſulfure, aut alumine, aut bitumine which is to be met with only in countries that have been ſubject to ſubterraneous

" ardentes maximos ignes: igitur penitus ignis, et
" flammæ vapor per intervenia permanans et ardens,
" efficet levem eam terram, et ibi, qui naſcitur tophus,
" exugens eſt, et ſine liquore. Ergo cum tres res con-
" ſimili ratione, ignis vehementia formatæ in unam
" pervenerint mixtionem, repente recepto liquore una
" cohæreſcunt, et celeriter humore duratæ ſolidantur,
" neque eas fluctus, neque vis aquæ poteſt diſſolvere."

About Baia, Puzzole, and Naples, we have an opportunity of remarking the truth of theſe laſt words. Several of the piers of the ancient harbour of Puzzole, vulgarly called Caligula's bridge, and which are compoſed of brick joined with this ſort of cement, are ſtill ſtanding in the ſea, though much expoſed to the waves; and upon every part of the ſhore you find large maſſes of brick-walls rounded and poliſhed by friction in the ſea, the brick and mortar making one body, and appearing like a variegated ſtone. Large pieces of old walls are likewiſe often cut out into ſquare pieces, and made uſe of in modern buildings inſtead of ſtone.

Soon after the firſt quotation, Pliny ſays, " Si ergo
" in his locis aquarum ferventes inveniuntur fontes, et
" in montibus excavatis calidi vapores, ipſaque loca ab
" antiquis memorantur pervagantes in agris habuiſſe
" ardores, videtur eſſe certum ab ignis vehementia ex
" topho terraque, quemadmodum in fornacibus et a
" calce, ita ex his ereptum eſſe liquorem. Igitur diſ-

fires. It is, I believe, a ſort of lime prepared by nature. This, mixed with water, great or ſmall pumice ſtones, fragments of lava, and burnt matter, may naturally be ſuppoſed to harden into a ſtone of this kind [g]; and, as water frequently attends eruptions of fire, as will be ſeen in the accounts I ſhall give of the formation of the new mountain near Puzzole, I am con-

" ſimilibus, et diſparibus rebus correptis, et in unam " poteſtatem collatis, callida humoris jejunitas aqua " repente ſatiata, communibus corporibus latenti calore " conferveſcit et vehementer effecit ea coire, celeriter" que una ſoliditatis percipere virtutem."

[g] Scipione Falcone, a very good obſerver, in his *Diſcorſo naturale delli cauſe et effetti del Veſuvio*, ſays, that he ſaw, after the eruption of Veſuvius in 1631 (which was attended with hot water), the mud harden almoſt to a ſtone in a few days; his words are theſe—" fatta dura a modo di calcina e di pietra non " altrimenti di cenere, perché dopò alcuni giorni vi " ci e caminato per ſopra e ſi e conoſciuta duriſſima " che ci vogliono li picconi per romperla." This account, with other circumſtances mentioned in this letter, make it highly probable, that all the *tufas* in the neighbourhood of Veſuvius have been formed by a like operation.

vinced the firſt matter that iſſued from Veſuvius, and covered Herculaneum, was in the ſtate of liquid mud. A circumſtance ſtrongly favouring my opinion is, that, about two years ago, I ſaw the head of an antique ſtatue dug out of this matter within the theatre of Herculaneum; the impreſſion of its face remains to this day in the *tufa*, and might ſerve as a mould for a caſt in plaiſter of Paris, being as perfect as any mould I ever ſaw. As much may be inferred from the exact reſemblance of this matter, or *tufa*, which immediately covers Herculaneum, to all the *tufas* of which the high grounds of Naples and its neighbourhood are compoſed; I detached a piece of it ſticking to, and incorporated with, the painted ſtucco of the inſide of the theatre of Herculaneum, and ſhall ſend it for your inſpection [*b*]. It is very different, as you will ſee, from the vitrified matter called lava, by which it has been generally thought that Herculaneum was deſtroyed. The village of Reſina and ſome villas ſtand at preſent above this unfortunate town.

[*b*] This piece is now in the Muſeum of the Royal Society, together with many other ſpecimens, mentioned in this and in the following letter. M. M.

To account for the very great difference of the matters that cover Herculaneum and Pompeii, I have often thought that, in the eruption of 79, the mountain muſt have been open in more than one place. A paſſage in Pliny's letter to Tacitus ſeems to ſay as much, "Interim è Veſuvio "monte pluribus locis latiſſimæ flammæ, "atque incendia relucebant, quorum ful-"gor et claritas tenebras noctis pellebat:" ſo that very probably the matter that covers Pompeii proceeded from a mouth, or crater, much nearer to it than is the great mouth of the Volcano, from whence came the matter that covers Herculaneum. This matter might nevertheleſs be ſaid to have proceeded from Veſuvius, juſt as the eruption in the year 1760, which was quite independent of the great crater (being four miles from it), is properly called an eruption of Veſuvius.

In the beginning of eruptions, Volcanos frequently throw up water mixed with the aſhes. Veſuvius did ſo in the eruption of 1631, according to the teſtimony of many contemporary writers. The ſame circumſtance happened in 1669, according to the account of Ignazzio Sorrentino, who, by his Hiſtory of Mount Veſuvius, printed at Naples in 1734, has ſhewn himſelf to have been a very accurate obſerver of the phænomena of the Volcano, for many years that he lived at Torre del Greco, ſituated at the foot of it. At the beginning of the formation of the new mountain, near Puzzole, water was mixed with the aſhes thrown up, as will be ſeen in two very curious and particular accounts of the formation of that mountain, which I ſhall have the pleaſure of communicating to you preſently; and in 1755, Etna threw up a quantity of water in the beginning of an eruption, as is mentioned in the letter I ſent you laſt year upon the ſubject of that magnificent Volcano[*i*]. Ulloa likewiſe mentions this circumſtance of water attending the eruptions of Volcanos in America. Whenever therefore I find a *tufa* compoſed exactly like that which immediately covers Herculaneum, and undoubtedly proceeded from Veſuvius, I conclude ſuch a *tufa* to have been produced by water mixing with the erupted matter at the time of an exploſion occaſioned by ſubterraneous fire; and this obſervation, I believe, will be of more uſe than any other, in pointing out thoſe parts of the preſent *terra firma*, that have been formed by exploſion. I am convinced, it has often happened that ſubterraneous fires and exhalations, after having been pent up and confined for ſome time, and been the cauſe of earthquakes, have forced their paſſage, and in venting themſelves formed mountains of the matter that confined them, as you will ſee was the caſe near Puzzole in the year 1538, and by evident ſigns has been ſo before, in many parts of the neighbourhood of Puzzole; without creating a regular Volcano. The materials of ſuch mountains will have but little appearance of having been produced by fire, to any one unaccuſtomed to make obſervations upon the different nature of Volcanos.

[*i*] Letter IV.

If it were allowed to make a compariſon between the earth and a human body, one might conſider a country replete with combuſtibles occaſioning exploſions (which is ſurely the caſe here) to be like a body full of humours. When theſe humours concentre in one part, and form a great tumour out of which they are diſcharged freely, the body is leſs agitated; but when, by any accident, the humours are checked, and do not find free paſſage through their uſual channel, the body is agitated, and tumours appear in other parts of that body, but ſoon after the humours return again to their former channel. In a ſimilar manner one may conceive Veſuvius to be the preſent great channel, through which nature diſcharges ſome of the foul humours of the earth: when theſe humours are checked by any accident or ſtoppage in this channel for any conſiderable time, earthquakes will be frequent in its neighbourhood, and exploſions may be apprehended even at ſome diſtance from it. This was the caſe in the year 1538, Veſuvius having been quiet for near 400 years. There was no eruption from its great crater, from the year 1139 to the great eruption of 1631, and the top of the mountain began to loſe all ſigns of fire. As it is not foreign to my purpoſe, and will ſerve to ſhew how greatly they are miſtaken, who place the ſeat of the fire in the centre, or towards the top, of a Volcano; I will give you a curious deſcription of the ſtate of the crater of Veſuvius, after having been free from eruption 492 years, as related by Bracini, who deſcended into it not long before the eruption of

1631:

1631: "The crater was five miles in circumference, and about a thouſand paces "deep; its ſides were covered with bruſh "wood, and at the bottom there was a "plain on which cattle grazed. In the "woody parts, boars frequently harboured; "in the midſt of the plain, within the "crater, was a narrow paſſage, through "which, by a winding path, you could "deſcend about a mile amongſt rocks and "ſtones, till you came to another more "ſpacious plain covered with aſhes: in "this plain were three little pools, placed "in a triangular form, one towards the "Eaſt, of hot water, corroſive and bitter "beyond meaſure; another towards the "Weſt, of water ſalter than that of the "ſea; the third of hot water, that had no "particular taſte."

The great increaſe of the cone of Veſuvius, from that time to this, naturally induces one to conclude, that the whole of the cone was raiſed in the like manner; and that the part of Veſuvius, called Somma, ma, which is now conſidered as a diſtinct mountain from it, was compoſed in the ſame manner. This may plainly be perceived, by examining its interior and exterior form, and the ſtrata of lava and burnt matter of which it is compoſed. The ancients, in deſcribing Veſuvius, never mention two mountains. Strabo, Dio, Vitruvius, all agree, that Veſuvius, in their time, ſhewed ſigns of having formerly erupted [k], and the firſt compares the

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[k] Strabo, in his fifth book of Geography, ſays, "Supra hæc loca ſitus eſt Veſuvius mons agris cinctus optimis: dempto vertice, qui magna ſui parte planus, totus ſterilis eſt, adſpectu cinæreus, cavernaſque oſtendens fiſtularum plenas et lapidum colore fuliginoſo, utpote ab igni exeſorum, ut conjecturam facere poſſit iſta loca quondam arſiſſe, et crateras ignis habuiſſe, deinde materia deficiente reſtincta fuiſſe."

Diodorus Siculus, in his fourth book, deſcribing the voyage of Hercules into Italy, ſays, "Phlegræus quoque campus is locus appellatur a colle nimirum, qui Ætnæ inſtar Siculæ magnam vim igniseructabat; nunc Veſuvius nominatur, multa inflammationis priſtinæ veſtigia reſervans." And Vitruvius, in the crater on its top to an amphitheatre. The mountain now called Somma was, I believe, that which the ancients called Veſuvius: its outſide form is conical; its inſide, inſtead of an amphitheatre, is now like a great theatre. I ſuppoſe the eruption in Pliny's time to have thrown down that part of the cone next the ſea, which would naturally have left it in its preſent ſtate; and that the conical mountain, or exiſting Veſuvius, has been raiſed by the ſucceeding eruptions: all my obſervations confirm this opinion. I have ſeen antient lavas in the plain on the other ſide of Somma, which could never have proceeded from the preſent Veſuvius. Serao, a celebrated phyſician now living at Na-

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ſixth chapter of the ſecond book, ſays, "Non minus "etiam memoratur antiquitus creviſſe ardores et abun"daſſe ſub Veſuvio monte et inde evomuiſſe circa agros "flammas." Tacitus, mentioning the eruption of Veſuvius in the reign of Titus, ſeems to hint likewiſe at former eruptions, in theſe words: "Jam verò novis "cladibus, vel poſt longam ſæculorum repetitis, af"flictæ, hauſtæ aut abrutæ fecundiſſima Campaniæ ora "et urbs incendiis vaſtata."

ples; in the introduction of his account of the eruption of Veſuvius in 1737 (in which account many of the phænomena of the Volcano are recorded and very well accounted for), ſays, that at the convent of Dominican Fryars, called the Madona del Arco, ſome years ago, in ſinking a well, at a hundred feet depth, a lava was diſcovered, and ſoon after another; ſo that, in leſs than three hundred feet depth, the lavas of four eruptions were found. From the ſituation of this convent it is clear beyond a doubt, that theſe lavas proceeded from the mountain called Somma, as they are quite out of the reach of the exiſting Volcano.

From theſe circumſtances, and from repeated obſervations I have made in the neighbourhood of Veſuvius, I am ſure that no virgin ſoil is to be found there, and that all is compoſed of different ſtrata of erupted matter, even to a great depth below the level of the ſea. In ſhort, I have not any doubt in my own mind, but that this Vol-

cano

cano took its riſe from the bottom of the ſea; and as the whole plain between Veſuvius and the mountains behind Caſerta, which is the beſt part of the Campagna Felice, is (under its good ſoil) compoſed of burnt matter, I imagine the ſea to have waſhed the feet of thoſe mountains, until the ſubterraneous fires began to operate, at a period certainly of a moſt remote antiquity.

The ſoil of the Campagna Felice is very fertile; I ſaw the earth opened in many places laſt year in the midſt of that plain, when they were ſeeking for materials to mend the road from Naples to Caſerta. The ſtratum of good ſoil was in general four or five feet thick; under which was a deep ſtratum of cinders, pumice, fragments of lava and ſuch burnt matter as abounds near Veſuvius and all Volcanos. The mountains at the back of Caſerta are moſtly of a ſort of lime-ſtone, and very different from thoſe formed by fire; though Signior Van Vitelli, the celebrated architect, has aſſured me, that in the cutting of the famous aqueduct of Caſerta through theſe mountains, he met with ſome foſſils, that had been evidently formed by ſubterraneous fires. The high grounds, which extend from Caſtel-a-Mare to the point of Minerva towards the iſland of Caprea, and from the promontory that divides the bay of Naples from that of Salerno, are of lime-ſtone. The plain of Sorrento, that is bounded by theſe high grounds, beginning at the village of Vico, and ending at that of Maſſa, is wholly compoſed of the ſame ſort of *tufa* as that about Naples, except that the cinder or pumice ſtones intermixed in it are larger than in the Naples *tufa*. I conceive then that there has been an exploſion in this ſpot from the bottom of the ſea. This plain, as I have remarked to be the caſe with all ſoils produced by ſubterraneous fire, is extremely fertile; whilſt the ground about it, being of another nature, is not ſo. The iſland of Caprea does not ſhew any ſigns of having been formed by ſubterraneous fire; but is of the ſame nature as the high grounds laſt mentioned, from which it has been probably detached by earthquakes, or the violence of the waves. Rovigliano, an iſland, or rather a rock in the bay of Caſtel-a-Mare, is likewiſe of lime-ſtone, and ſeems to have belonged to the original mountains in its neighbourhood: in ſome of theſe mountains there are alſo petrified fiſh and foſſil ſhells, which I never have found in the mountains, which I ſuppoſe to have been formed by exploſion[l].

You have now, Sir, before you the nature of the ſoil, from Caprea to Naples. The ſoil on which this great metropolis ſtands has been evidently produced by exploſions, ſome of which ſeem to have been upon the very ſpot on which this city is built; all the high grounds round Naples, Pauſilipo, Puzzole, Baïa, Miſenum, the iſlands of Procita and Iſchia, all appear to have been raiſed by exploſion. You can trace ſtill in many of theſe heights the conical ſhape that was naturally given them at firſt, and even the craters out of which the matter iſſued, though to be ſure others of theſe heights have ſuffered ſuch changes by the hand of time, that you can only conjecture that they were raiſed in the like manner, by their compoſition being exactly the ſame as that of thoſe mountains, which ſtill retain their conical form and craters entire. A *tufa*, exactly reſembling the ſpecimen I took from the inſide of the theatre of Herculaneum, layers of pumice intermixed with layers of good ſoil, juſt like thoſe over Pompeii, and lavas like thoſe of Veſuvius, compoſe the whole ſoil of the country that remains to be deſcribed.

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[l] Bracini, in his account of the eruption of 1613, ſays, that he found many ſorts of ſea ſhells on Veſuvius after that eruption; and P. Ignatio, in his account of the ſame eruption, ſays, that he and his companions picked up many ſhells likewiſe at that time upon the mountain; this circumſtance would induce one to believe, that the water thrown out of Veſuvius, during that formidable eruption, came from the ſea.

The

The famous grotto anciently cut through the mountain of Pauſilipo, to make a road from Naples to Puzzole, gives you an opportunity of ſeeing that the whole of that mountain is *tufa*. The firſt evident crater you meet with, after you have paſſed the grotto of Pauſilipo, is now the lake of Agnano; a ſmall remain of the ſubterraneous fire (which muſt probably have made the baſon for the lake, and raiſed the high grounds which form a ſort of amphitheatre round it) ſerves to heat rooms, which the Neapolitans make great uſe of in ſummer, for carrying off diverſe diſorders, by a ſtrong perſpiration. This place is called the Sudatorio di San Germano; near the preſent bagnios, which are but poor little hovels, there are the ruins of a magnificent ancient bath. About an hundred paces from hence is the Grotto del Cane; I ſhall only mention, as a further proof of the probability that the lake of Agnano was a Volcano, that vapours of a pernicious quality, as that in the Grotto del Cane, are frequently met with in the neighbourhood of Etna and Veſuvius, particularly at the time of, before, and after, great eruptions. The noxious vapour having continued in the ſame force conſtantly ſo many ages, as it has done in the Grotto del Cane (for Pliny mentions this Grotto [m]), is indeed a circumſtance in which it differs from the vapours near Veſuvius and Etna, which are not conſtant; the cone forming the outſide of this ſuppoſed Volcano is ſtill perfect in many parts.

Oppoſite to the Grotto del Cane, and immediately joining to the lake, riſes the mountain called Aſtruni, which, having, as I imagine, been thrown up by an exploſion of a much later date, retains the conical ſhape and every ſymptom of a Volcano in much greater perfection than that I have been deſcribing. The crater of Aſtruni is ſurrounded with a wall, to confine boars and deer; (this Volcano having been for many years converted to a royal chace). It may be about ſix miles or more in circumference; in the plain at the bottom of the crater are two lakes; and in ſome books there is mention made of a hot ſpring, which I never have been able to find. There are many huge rocks of lava within the crater of Aſtruni, and ſome I have met with alſo in that of Aghano; the cones of both theſe ſuppoſed Volcanos are compoſed of *tufa* and ſtrata of looſe pumice, fragments of lava and other burnt matter, exactly reſembling the ſtrata of Veſuvius. Bartholomeus Fatius, who wrote of the actions of King Alphonſo the Firſt (before the new mountain had been formed near Puzzole), conjectured that Aſtruni had been a Volcano. Theſe are his words: "Locus Neapoli quatuor millia paſſuum "proximus, quem vulgo Liſtrones vocant, "nos unum è Phlegræis Campis ab ardore "nuncupandum putamus." There is no entrance into the crater of either Aſtruni or Agnano, except one, evidently made by art, and they both exactly correſpond with Strabo's deſcription of Avernus; the ſame may be ſaid of the Solfaterra and the Monte Gauro, or Barbaro as it is ſometimes called, which I ſhall deſcribe preſently.

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[m] In book xi. c. 93. he obſerves, that about Sinueſſa and Puteoli, “ Spiracula vocant—alii Charoneas ſcrobes, mortiferum ſpiritum exhalantes.” And Seneca, Nat. Quæſt. lib. vi. cap. 28. “ Pluribus Italiæ “ locis per quædam foramina peſtilens exhalatur vapor, “ quem non homini ducere, non feræ tutum eſt. “ Aves quoque ſi in illum inciderint, antequam cœlo “ meliore leniatur, in ipſo volatu cadunt, liventque “ corpora, et non aliter quam per vim eliſæ fauces “ tument.”

Near Aſtruni and towards the ſea riſes the Solfaterra, which not only retains its cone and crater, but much of its former heat. In the plain within the crater, ſmoak iſſues from many parts, as alſo from its ſides; here, by means of ſtones and tiles heaped over the crevices, through which the ſmoak paſſes, they collect in an aukward manner what they call *ſale armoniaco*; and from the ſand of the plain they extract ſulphur and alum. This ſpot, well attended to, might certainly produce a good revenue, whereas I doubt if they have hitherto ever cleared 200 *l.* a year by it. The hollow ſound produced by throwing a heavy ſtone on the plain of the crater of the Solfaterra ſeems to indicate, that it is ſupported by a ſort of arched natural vault; and one is induced to think that there is a pool of water beneath this vault (which boils by the heat of a ſubterraneous fire ſtill deeper), by the very moiſt ſtream that iſſues from the cracks in the plain of the Solfaterra, which, like that of boiling water, runs off a ſword or knife, preſented to it, in great drops. On the outſide, and at the foot of the cone of the Solfaterra, towards the lake of Agnano, water ruſhes out of the rocks, ſo hot, as to raiſe the quickſilver in Fahrenheit's thermometer to the degree of boiling water [*n*], a fact of which I was myſelf an eye-witneſs. This place, well worthy the obſervation of the curious, has been taken little notice of; it is called the *Piſciarelli*. The common people of Naples have great faith in the efficacy of this water; and make much uſe of it in all cutaneous diſorders, as well as for another diſorder that prevails here. It ſeems to be impregnated chiefly with ſulphur and alum. When you approach your ear to the rocks of the Piſciarelli, from whence this water ouzes, you hear a horrid boiling noiſe, which ſeems to proceed from the huge cauldron, that may be ſuppoſed to be under the plain of the Solfaterra. On the other ſide of the Solfaterra, next the ſea, there is a rock which has communicated with the ſea, till part of it was cut away to make the road to Puzzole; this was undoubtedly a conſider-

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[*n*] I have remarked, that after a great fall of rain, the degree of heat in this water is much leſs, which will account for what the Padre Torre ſays (in his

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book, entituled, *Hiſtoire et Phenomenes du Veſuve*), that when he tried it in company with Monſieur de la Condamine, the degree of heat, upon Reaumur's thermometer, was 68°.

able lava, that ran from the Solfaterra when it was an active Volcano. Under this rock of lava, which is more than ſeventy feet high, there is a ſtratum of pumice and aſhes. This ancient lava is about a quarter of a mile broad; you meet with it abruptly before you come in ſight of Puzzole, and it finiſhes as abruptly within about an hundred paces of the town. I have often thought that many quarries of ſtone, upon examination, would be found to owe their origin to the ſame cauſe, though time may have effaced all ſigns of the Volcano from whence they proceeded. Except this rock, which is evidently lava and full of vitrifications like that of Veſuvius, all the rocks upon the coaſt of Baïa are of *tufa*.

I have obſerved in the lava of Veſuvius and Etna, as in this, that the bottom, as well as the ſurface of it, was rough and porous, like the cinders or ſcoriæ from an iron foundery; and that for about a foot from the ſurface and from the bottom, they were not near ſo ſolid and compact as towards the centre; which muſt undoubtedly proceed from the impreſſion of the air upon the vitrified matter whilſt in fuſion. I mention this circumſtance, as it may ſerve to point out true lava's with more certainty. The ancient name of the Solfaterra was, *Forum Vulcani*; a ſtrong proof of its origin from ſubterraneous fire. The degree of heat that the Solfaterra has preſerved for ſo many ages, ſeems to have calcined the ſtones upon its cone, and in its crater, as they are very white, and crumble eaſily in the hotteſt parts.

We come next to the new mountain near Puzzole, which, being of ſo very late a formation, preſerves its conical ſhape entire, and produces as yet but a very ſlender vegetation. It has a crater almoſt as deep as the cone is high, which may be near a quarter of a mile perpendicular, and is in ſhape a regular inverted cone. At the baſis of this new mountain (which is more than three miles in circumference), the ſand upon the ſea ſhore, and even that which is waſhed by the ſea itſelf, is burning hot for above the ſpace of an hundred yards; if you take up a handful of the ſand below water, you are obliged to get rid of it directly, on account of its intenſe heat.

I had been long very deſirous of meeting with a good account of the formation of this new mountain, becauſe, proving this mountain to have been raiſed by mere exploſion in a plain, would prove at the ſame time, that all the neighbouring mountains, which are compoſed of the ſame materials, and have exactly or in part the ſame form, were raiſed in the like manner; and that the ſeat of fire, the cauſe of theſe exploſions, lies deep; which I have every reaſon to think.

Fortunately, I lately found two very good accounts of the phænomena that attended the exploſion, which formed the new mountain, publiſhed a few months after the event. As I think them very curious,

rious, and greatly to my purpoſe, and as they are rare, I will give you a literal tranſlation of ſuch extracts as relate to the formation of the Monte Nuovo. They are bound in one volume [o].

The title of the firſt is, *Dell Incendio di Pozzuolo, Marco Antonio delli Falconi all Illuſtriſſima Signiora Marcheſa della Padula nel* MDXXXVIII.

At the head of the ſecond is, *Ragionamento del Terremoto, del Nuovo Monte, del Aprimento di Terra in Pozzuolo nell' Anno* 1538, *é della ſignificatione d'eſſi. Per Piero Giacomo da Toledo*; and at the end of the book, *Stampata in Nap. per Giovanni Sulztbach Alemano, a* 22*di Genaro* 1539, *con gratia, é privilegio.*

" Firſt then (ſays Marco Antonio delli " Falconi), will I relate ſimply and exactly " the operations of nature, of which I was " either myſelf an eye-witneſs, or as they " were related to me by thoſe who had

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[o] This very ſcarce volume has been preſented by Sir William Hamilton to the British Muſeum. M. M.

" been witneſſes of them. It is now two
" years that there have been frequent
" earthquakes at Pozzuolo, at Naples,
" and the neighbouring parts; on the
" day and in the night before the ap-
" pearance of this eruption, above twenty
" ſhocks great and ſmall were felt at the
" abovementioned places. The eruption
" made its appearance the 29th of Septem-
" ber 1538, the feaſt of St. Michael the
" angel; it was on a Sunday, about an
" hour in the night; and, as I have been
" informed, they began to ſee on that ſpot,
" between the hot baths or ſweating
" rooms, and Trepergule, flames of fire,
" which firſt made their appearance at
" the baths, then extended towards Tre-
" pergule, and fixing in the little valley that
" lies between the Monte Barbaro and the
" hillock called del Pericolo (which was
" the road to the lake of Avernus and
" the baths), in a ſhort time the fire in-
" creaſed to ſuch a degree, that it burſt
" open the earth in this place, and threw
" up

" up ſo great a quantity of aſhes and " pumice ſtones mixed with water, as " covered the whole country; and in Naples a ſhower of theſe aſhes and water " fell great part of the night. The next " morning, which was Monday, and the " laſt of the month, the poor inhabitants " of Pozzuolo, ſtruck with ſo horrible a " ſight, quitted their habitations, covered with that muddy and black ſhower, " which continued in that country the " whole day, flying death, but with faces " painted with its colours; ſome with their " children in their arms ſome with ſacks " full of their goods; others leading an " aſs loaded with their frightened family " towards Naples; others carrying quantities of birds of various ſorts that had " fallen dead at the time the eruption " began; others again with fiſh which they " had found, and were to be met with " in plenty upon the ſhore, the ſea having been at that time conſiderably dried " up. Don Petro di Toledo, Viceroy

" of the kingdom, with many gentlemen, " went to ſee ſo wonderful an appear- " ance; I alſo, having met with the moſt " honourable and incomparable gentle- " man, Signior Fabritio Moramaldo, on " the road, went and ſaw the eruption " and the many wonderful effects of it. " The ſea towards Baïa had retired a " conſiderable way; though from the " quantity of aſhes and broken pumice " ſtones thrown up by the eruption, it " appeared almoſt totally dry. I ſaw " likewiſe two ſprings in thoſe lately-diſ- " covered ruins, one before the houſe that " was the Queen's, of hot and ſalt water; " the other of freſh and cold water, on " the ſhore, about 250 paces nearer to " the eruption: ſome ſay, that ſtill nearer " to the ſpot where the eruption hap- " pened, a ſtream of freſh water iſſued " forth like a little river. Turning to- " wards the place of the eruption, you " ſaw mountains of ſmoke, part of which " was very black and part very white,

“ riſe up to a great height; and in the midſt of the ſmoke, at times, deep-coloured flames burſt forth with huge ſtones and aſhes, and you heard a noiſe like the diſcharge of a number of great artillery. It appeared to me as if Typheus and Enceladus from Iſchia and Etna with innumerable giants, or thoſe from the Campi Phlegrei (which according to the opinions of ſome were ſituated in this neighbourhood), were come to wage war again with Jupiter. The natural hiſtorians may perhaps reaſonably ſay, that the wiſe poets meant no more by giants, than exhalations, ſhut up in the bowels of the earth, which, not finding a free paſſage, open one by their own force and impulſe, and form mountains, as thoſe which occaſioned this eruption have been ſeen to do; and methought I ſaw thoſe torrents of burning ſmoke that Pindar deſcribes in an eruption of Etna, now called Mon Gibello in Sicily; in imitation of

" which, as ſome ſay, Virgil wrote theſe
" lines:

" Ipſe ſed horrificis juxta tonat Ætna ruinis, &c.

" After the ſtones and aſhes with clouds " of thick ſmoke had been ſent up, by " the impulſe of the fire and windy exhalation (as you ſee in a great cauldron " that boils), into the middle region of " the air, overcome by their own natural " weight, when from diſtance the ſtrength " they had received from impulſe was " ſpent, rejected likewiſe by the cold and " unfriendly region, you ſaw them fall " thick, and, by degrees, the condenſed " ſmoak clear away, raining aſhes with " water and ſtones of different ſizes, according to the diſtance from the place: " then, by degrees, with the ſame noiſe " and ſmoke it threw out ſtones and aſhes " again, and ſo on by fits. This continued two days and nights, when the " ſmoke and force of the fire began to " abate. The fourth day, which was

"Thurſday at 22 o'clock, there was ſo
"great an eruption, that, as I was in the
"gulph of Puzzole coming from Iſchia,
"and not far from Miſenum, I ſaw, in
"a ſhort time, many columns of ſmoke
"ſhoot up, with the moſt terrible noiſe
"I ever heard, and, bending over the ſea,
"came near our boat, which was four
"miles or more from the place of their
"birth; and the quantity of aſhes, ſtones,
"and ſmoke, ſeemed as if they would
"cover the whole earth and ſea. Stones,
"great and ſmall, and aſhes more or leſs,
"according to the impulſe of the fire
"and exhalations, began to fall, ſo that
"a great part of this country was cover-
"ed with aſhes; and many that have ſeen
"it, ſay, they reached the vale of Diana,
"and ſome parts of Calabria, which are
"more than 150 miles from Pozzuolo.
"The Friday and Saturday nothing but
"a little ſmoke appeared; ſo that many,
"taking courage, went upon the ſpot,
"and ſay, that with the ſtones and aſhes

" thrown up, a mountain has been form-
" ed in that valley, not leſs than three
" miles in circumference, and almoſt as
" high as the Monte Barbaro, which is
" near it, covering the Canettaria, the caſtle
" of Trepergule, all thoſe buildings and
" the greateſt part of the baths that were
" about them; extending South towards
" the ſea, North as far as the lake of
" Avernus, Weſt to the Sudatory, and
" joining Eaſt to the foot of the Monte
" Barbaro; ſo that this place has changed
" its form and face in ſuch a manner as
" not to be known again, a thing almoſt
" incredible to thoſe who have not ſeen
" it, that in ſo ſhort a time ſo conſidera-
" ble a mountain could have been form-
" ed. On its ſummit there is a mouth
" in the form of a cup, which may be a
" quarter of a mile in circumference,
" though ſome ſay it is as large as our
" market-place at Naples, from which
" there iſſues a conſtant ſmoke; and
" though I have ſeen it only at a diſtance,
" it

“ it appears very great. The Sunday fol-
“ lowing, which was the 6th of October,
“ many people going to ſee this phæno-
“ menon, and ſome having aſcended half
“ the mountain, others more, about 22
“ o'clock there happened ſo ſudden and
“ horrid an eruption, with ſo great a
“ ſmoke, that many of theſe people were
“ ſtifled, ſome of which could never be
“ found. I have been told, that the num-
“ ber of the dead or loſt amounted to
“ twenty-four. From that time to this,
“ nothing remarkable happened; it ſeems
“ as if the eruption returned periodically,
“ like the ague or gout. I believe hence-
“ forward it will not have ſuch force,
“ though the eruption of the Sunday was
“ accompanied with ſhowers of aſhes and
“ water, which fell at Naples, and were
“ ſeen to extend as far as the mountain
“ of Somma, called Veſuvius by the an-
“ cients; and, as I have often remarked,
“ the clouds of ſmoke proceeding from
“ the eruption, moved in a direct line

" towards that mountain, as if theſe places " had a correſpondence and connection " one with the other. In the night, many " beams and columns of fire were ſeen " to proceed from this eruption, and ſome " like flaſhes of lightening [p]. We have " then, many circumſtances for our ob- " ſervation, the earthquakes, the eruption, " the drying up of the ſea, the quantity " of dead fiſh and birds, the birth of " ſprings, the ſhower of aſhes with water, " and without water, the innumerable trees " in that whole country, as far as the " Grotto of Lucullus, torn from their " roots, thrown down, and covered with " aſhes, that it gave one pain to ſee them: " and as all theſe effects were produced by " the ſame cauſe that produces earth- " quakes; let us firſt enquire how earth- " quakes are produced, and from thence " we may eaſily comprehend the cauſe of " the abovementioned events." Then follows a diſſertation on earthquakes, and ſome curious conjectures relative to the phænomena which attended this eruption, clearly and well expreſſed, conſidering, as the author himſelf apologizes, that at that time the Italian language had been little employed on ſuch ſubjects.

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[p] Here again we have an example of the electrical fire attending a great eruption.

The account of the formation of the Monte Nuovo, by Pietro Giacomo di Toledo, is given in a dialogue between the feigned perſonages of Peregrino and Sveſſano; the former of which ſays, "It is "now two years that this province of "Campagna has been afflicted with earth-"quakes, the country about Pozzuolo "much more ſo than any other parts; but "the 27th and the 28th of the month of "September laſt, the earthquakes did not "ceaſe day or night, in the abovementioned "city of Pozzuolo; that plain, which lies "between the lake of Averno, the Monte "Barbaro, and the ſea, was raiſed a little, "and many cracks were made in it, from "ſome of which iſſued water; and at the

" ſame time the ſea, which was very near the
" plain, dried up about two hundred paces,
" ſo that the fiſh were left on the ſand,
" a prey to the inhabitants of Pozzuolo.
" At laſt, on the 29th of the ſaid month,
" about two hours in the night, the earth
" opened near the lake, and diſcovered a
" horrid mouth, from which were vo-
" mited furiouſly, ſmoke, fire, ſtones, and
" mud compoſed of aſhes; making, at the
" time of its opening, a noiſe like very
" loud thunder: the fire, that iſſued from
" this mouth, went towards the walls of
" the unfortunate city; the ſmoke was
" partly black and partly white; the black
" was darker than darkneſs itſelf, and the
" white was like the whiteſt cotton: theſe
" ſmokes, riſing in the air, ſeemed as if
" they would touch the vault of heaven;
" the ſtones that followed, were, by the
" devouring flames, converted to pumice,
" the ſize of which (of ſome I ſay) were
" much larger than an ox. The ſtones
" went about as high as a croſs-bow can
" carry,

“ carry, and then fell down, ſometimes
“ on the edge, and ſometimes into the
“ mouth itſelf. It is very true that many
“ of them in going up could not be ſeen,
“ on account of the dark ſmoke; but
“ when they returned from the ſmoky
“ heat, they ſhewed plainly where they
“ had been, by their ſtrong ſmell of fetid
“ ſulphur, juſt like ſtones that have been
“ thrown out of a mortar, and have paſ-
“ ſed through the ſmoke of inflamed gun-
“ powder. The mud was of the colour
“ of aſhes, and at firſt very liquid, then
“ by degrees leſs ſo; and in ſuch quan-
“ tities, that in leſs than twelve hours,
“ with the help of the abovementioned
“ ſtones, a mountain was raiſed of a
“ thouſand paces in height. Not only
“ Pozzuolo and the neighbouring country
“ was full of this mud, but the city of
“ Naples alſo, the beauty of whoſe pa-
“ laces were, in a great meaſure, ſpoiled
“ by it. The aſhes were carried as far as
“ Calabria by the force of the winds,

" burning up in their paſſage the graſs " and high trees, many of which were " borne down by the weight of them. " An infinity of birds alſo, and number- " leſs animals of various kinds, covered " with this ſulphureous mud, gave them- " ſelves up a prey to man. Now this " eruption laſted two nights and two days " without intermiſſion, though, it is true, " not always with the ſame force, but " more or leſs: when it was at its greateſt " height, even at Naples you heard a " noiſe or thundering like heavy artillery " when two armies are engaged. The " third day the eruption ceaſed, ſo that " the mountain made its appearance un- " covered, to the no ſmall aſtoniſhment " of every one who ſaw it. On this " day, when I went up with many peo- " ple to the top of this mountain; I ſaw " down into its mouth, which was a round " concavity of about a quarter of a mile " in circumference, in the middle of which " the ſtones that had fallen were boil-

“ ing up, juſt as in a great cauldron of “ water that boils on the fire. The fourth “ day it began to throw up again, and the “ ſeventh much more, but ſtill with leſs “ violence than the firſt night; it was at this “ time that many people, who were un-“ fortunately on the mountain, were either “ ſuddenly covered with aſhes, ſmothered “ with ſmoke, or knocked down by ſtones, “ burnt by the flame, and left dead on the “ ſpot. The ſmoke continues to this “ day [*q*], and you often ſee in the night-“ time fire in the midſt of it. Finally, to “ complete the hiſtory of this new and “ unforeſeen event, in many parts of the “ new-made mountain, ſulphur begins to “ be generated.” Giacomo di Toledo, towards the end of his diſſertation upon the phænomena attending this eruption, ſays, that the lake of Avernus had a communication with the ſea, before the time of the eruption; and that he apprehended that the air of Puzzole might come to be affected in ſummer time, by the vapours from the ſtagnated waters of the lake; which is actually the caſe.

[*q*] The cup, or crater, on the top of the new mountain is now covered with ſhrubs; but I diſcovered at the bottom of it, in the year 1770, amidſt the buſhes, a ſmall hole, which exhales a conſtant hot and damp vapour, juſt ſuch as proceeds from boiling water, and with as little ſmell; the drops of this ſteam hang upon the neighbouring buſhes.

You have, Sir, from theſe accounts, an inſtance of a mountain, of a conſiderable height and dimenſions, formed in a plain, by mere exploſion, in the ſpace of forty-eight hours. The earthquakes having been ſenſibly felt at a great diſtance from the ſpot where the opening was made, proves clearly, that the ſubterraneous fire was at a great depth below the ſurface of the plain; it is as clear that thoſe earthquakes, and the exploſion, proceeded from the ſame cauſe, the former having ceaſed upon the appearance of the latter. Does not this circumſtance evidently contradict the ſyſtem of M. Buffon, and of all the natural hiſtorians, who have placed the ſeat of the fire of Volcanos towards the center, or near the ſummit of the mountains, which they ſuppoſe to furniſh the matter emitted? Did the matter which proceeds from a Volcano in an eruption come from ſo inconſiderable a depth as they imagine, that part of the mountain ſituated above their ſuppoſed ſeat of the fire muſt neceſſarily be deſtroyed, or diſſipated in a very ſhort time: on the contrary, an eruption uſually adds to the height and bulk of a Volcano; and who, that has had an opportunity of making obſervations on Volcanos does not know, that the matter they have emitted for many ages, in lavas, aſhes, ſmoke, &c. could it be collected together, would more than ſuffice to form three ſuch mountains as the ſimple cone or mountain of the exiſting Volcano? With reſpect to Veſuvius, this could be plainly proved; and I refer to my letter upon the ſubject of Etna, to ſhew the quantity of matter thrown up in one ſingle eruption, by that terrible Volcano. Another proof, that the real ſeat of the fire of Volcanos lies even greatly below the general level of the country whence the mountain ſprings, is, that was it only at an inconſiderable depth below the baſis of the mountain, the quantity of matter thrown up would ſoon leave ſo great a void immediately under it, that the mountain itſelf muſt undoubtedly ſink and diſappear after a few eruptions.

In the above accounts of the formation of the new mountain, we are told that the matter firſt thrown up, was mud compoſed of water and aſhes, mixed with pumice ſtones and other burnt matter: on the road leading from Puzzole to Cuma, part of the cone of this mountain has been cut away to widen the road. I have there ſeen that its compoſition is a *tufa* intermixed with pumice, ſome of which are really of the ſize of an ox, as mentioned in Toledo's account, and exactly of the ſame nature as the *tufa* of which every other high ground in its neighbourhood is compoſed; ſimilar alſo to that which covers

Herculaneum. According to the above accounts, after the muddy ſhower ceaſed, it rained dry aſhes: this circumſtance will account for the ſtrata of looſe pumice and aſhes, that are generally upon the ſurface of all the *tufas* in this country, and which were moſt probably thrown up in the ſame manner. At the firſt opening of the earth, in the plain near Puzzole, both accounts ſay, that ſprings of water burſt forth; this water, mixing with the aſhes, certainly occaſioned the muddy ſhower; when the ſprings were exhauſted, there muſt naturally have enſued a ſhower of dry aſhes and pumice, of which we have been likewiſe aſſured. I own, I was greatly pleaſed at being in this manner enabled to account ſo well for the formation of theſe *tufa* ſtones and the veins of dry and looſe burnt matter above them, of which the ſoil of almoſt the whole country I am deſcribing is compoſed; and I do not know that any one has ever attended to this circumſtance, though I find that many authors, who have deſcribed this country, have ſuſpected that parts of it were formed by exploſion. Wherever then this ſort of *tufa* is found, there is certainly good authority to ſuſpect its having been formed in the ſame manner as the *tufa* of this new mountain; for, as I ſaid before, Nature is generally uniform in all her operations.

It is commonly imagined that the new mountain roſe out of the Lucrine lake which was deſtroyed by it; but in the above account, no mention is made of the Lucrine lake; it may be ſuppoſed then, that the famous dam, which Strabo and many other ancient authors mention to have ſeparated that lake from the ſea, had been ruined by time or accident, and that the lake became a part of the ſea before the exploſion of 1538.

If the above-deſcribed eruption was terrible, that which formed the Monte Barbaro (or Gauro, as it was formerly called), ſt have been dreadful indeed. It joins immediately to the new mountain, which in ſhape and compoſition it exactly reſembles; but it is at leaſt three times as conſiderable. Its crater cannot be leſs than ſix miles in circumference; the plain within the crater, one of the moſt fertile ſpots I ever ſaw, is about four miles in circumference: there is no entrance to this plain, but one on the Eaſt ſide of the mountain, made evidently by art; in this ſection you have an opportunity of ſeeing that the matter, of which the mountain is compoſed is exactly ſimilar to that of the Monte Nuovo. It was this mountain that produced (as ſome authors have ſuppoſed) the celebrated Falernian wine of the ancients.

Cuma, allowed to have been the moſt ancient city of Italy, was built on an eminence, which is likewiſe compoſed of *tufa*, and may be naturally ſuppoſed a ſection of the cone formed by a very ancient exploſion.

The lake of Avernus fills the bottom of the crater of a mountain, undoubtedly produced by exploſion, and whoſe interior and exterior form, as well as the matter of which it is compoſed, exactly reſemble the Monte Barbaro and Monte Nuovo. At that part of the baſis of this mountain which is waſhed by the ſea of the bay of Puzzole, the ſand is ſtill very hot, though conſtantly waſhed by the waves; and into the cone of the mountain, near this hot ſand, a narrow paſſage of about 100 paces in length is cut, and leads to a fountain of boiling water, which, though brackiſh, boils fiſh and fleſh without giving them any bad taſte or quality, as I have experienced more than once. This place is called Nero's bath, and is ſtill made uſe of for a ſudatory, as it was by the ancients; the ſteam that riſes from the hot fountain abovementioned, confined in the narrow ſubterraneous paſſage, ſoon produces a violent perſpiration upon the patient who ſits therein. This bath is reckoned a great ſpecifick in that diſtemper which is ſuppoſed to have made its appearance at Naples, before it ſpread its contagion over the other parts of Europe.

Virgil and other ancient authors ſay, that birds could not fly with ſafety over the lake of Avernus, but that they fell therein; a circumſtance favouring my opinion, that this was once the mouth of a Volcano. The vapour of the ſulphur and other minerals muſt undoubtedly have been more powerful, the nearer we go back to the time of the exploſion of the Volcano; and I am convinced that there are ſtill ſome remains of thoſe vapours upon this lake, as I have obſerved there are very ſeldom any water-fowl upon it; and that when they do go there, it is but for a ſhort time, whilſt all the other lakes in the neighbourhood are conſtantly covered with them, in the winter ſeaſon. Upon Mount Veſuvius, in the year 1766, during an eruption, when the air was impregnated with noxious vapours, I have myſelf picked up dead birds frequently.

The caſtle of Baïa ſtands upon a conſiderable eminence, compoſed of the uſual *tufa* and ſtrata of pumice and aſhes; from which I concluded I ſhould find ſome remains of the craters from whence the matter iſſued: accordingly, having aſcended the hill, I ſoon diſcovered two very viſible craters, juſt behind the caſtle.

The lake called the Mare-morto was alſo, moſt probably, the crater, from whence iſſued the materials which formed the Promontory of Miſenum, and the high grounds around this lake. Under the ruins of an ancient building near the point of Miſenum, in a vault, there is a vapour, or *mofete*, exactly ſimilar in its effects to that of the Grotto del Cane, as I have often experienced.

The form of the little iſland of Niſida ſhews plainly its origin [*r*]. It is half a hollow cone of a Volcano cut perpendicularly; the half crater forms a little harbour called the Porto Pavone; I ſuppoſe the other half of the cone to have been detached into the ſea by earthquakes, or perhaps by the violence of the waves, as the part that is wanting is the ſide next to the open ſea.

[*r*] The noxious vapours which Lucan mentions to have prevailed at Niſida, favour my opinion as to its origin:

"— Tali ſpiramine Neſis
"Emittit ſtygium nebuloſis aëra ſaxis."

Lucan. lib. vi.

The fertile and pleaſant iſland of Procita ſhews alſo moſt evident ſigns of its production by exploſion, the nature of its ſoil being directly ſimilar to that of Baïa and Puzzole; this iſland ſeems really, as was imagined by the ancients, to have been detached from the neighbouring iſland of Iſchia.

There is no ſpot, I believe, that could afford a more ample field for curious obſervations, than the iſland of Iſchia, called Enaria, Inarime, and Pithecuſa, by the ancients. I have viſited it three times; and this ſummer paſſed three weeks there, during which time I examined, with attention, every part of it. Iſchia is eighteen miles in circumference: the whole of its ſoil is the ſame as that near Veſuvius, Naples, and Puzzole. There are numberleſs ſprings, hot, warm, and cold [s], diſperſed over the whole iſland, the waters of which are impregnated with minerals of various ſorts; ſo that, if you give credit to the inhabitants of the country, there is no diſorder but what finds its remedy here. In the hot months (the ſeaſon for making uſe of theſe baths), thoſe who have occaſion for them flock hither from Naples. A charitable inſtitution ſends and maintains three hundred poor patients at the baths of Gurgitelli every ſeaſon. By what I could learn of theſe poor patients, thoſe baths have really done wonders, in caſes attended with obſtinate tumours, and in contractions of the tendons and muſcles. The patient begins by bathing, and then is buried in the hot ſand near the ſea. In many parts of the iſland, the ſand is burning hot, even under water. The ſand on ſome parts of the ſhore is almoſt entirely compoſed of particles of iron ore; at leaſt they are attracted by the load-ſtone, as I have experienced. Near that part of the iſland called Lacco, there is a rock of an ancient lava, forming a ſmall cavern, which is ſhut up with a door; this cavern is made uſe of to cool liquors and fruit, which it does in a ſhort time as effectually as ice. Before the door was opened, I felt the cold to my legs very ſenſibly; but when it was opened, the cold ruſhed out ſo as to give me pain; and within the grotto it was intolerable. I was not ſenſible of wind attending this cold; though upon Mount Etna and Mount Veſuvius, where there are caverns of this kind, the cold is evidently occaſioned by a ſubterraneous wind: the natives call ſuch places *ventaroli.* May not the quantity of nitre, with which all theſe places abound, account in ſome meaſure for ſuch extreme cold? My thermometer was unluckily broken, or I would have informed you of the exact degree of the cold in this *ventaroli* of Iſchia, which is by much the ſtrongeſt in its effects I ever felt. The ancient lavas of Iſchia ſhew, that the eruptions there have been very formidable; and, hiſtory informs us, that its firſt inhabitants were driven out of the iſland by the frequency and the violence of them. There are ſome of theſe ancient lavas not leſs than two hundred feet in depth. The mountain of St. Nicola, on which there is at preſent a convent of hermits, was called by the ancients Epomeus; it is as high, if not higher, than Veſuvius, and appears to me to be a ſection of the cone of the ancient and principal Volcano of the iſland, its compoſition being all *tufa* or lava. The cells of the convent abovementioned are cut out of the mountain itſelf; and there you ſee plainly that its compoſition no way differs from the matter that covers Herculaneum, and forms the Monte Nuovo.

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[s] Giulio Ceſare Capaccio, in his account of this iſland, ſays, that there are eleven ſprings of cold water, and thirty-five of hot and mineral waters.

There is no ſign of a crater on the top of this mountain, which riſes almoſt to a ſharp point; time, and other accidents, may be reaſonably ſuppoſed to have worn away this diſtinctive mark of its having been formed by exploſion, as I have ſeen to be the caſe in other mountains, formed evidently by exploſion, on the flanks of Etna and Veſuvius. Strabo, in his 5th book, upon the ſubject of this iſland, quotes Timæus, as having ſaid, that, a little before his time, a mountain in the middle of Pithecuſa, called Epomeus, was ſhook by an earthquake, and vomited flames.

Thre are many other riſing grounds in this iſland, that, from the nature of their compoſition, muſt lead one to think the ſame as to their origin. Near the village of Caſtiglione, there is a mountain formed ſurely by an exploſion of a much later date, having preſerved its conical form and crater entire, and producing as yet but a ſlender vegetation: there is no account, however, of the date of this eruption.

Nearer the town of Iſchia, which is on the ſea ſhore, at a place called *Le Cremate*, there is a crater, from which, in the year 1301 or 1302, a lava ran quite into the ſea; there is not the leaſt vegetation on this lava, but it is nearly in the ſame ſtate as the modern lavas of Veſuvius. Pontano, Maranti, and D. Franceſco Lombardi, have recorded this eruption; the latter of whom ſays, that it laſted two months, that many men and beaſts were killed by the exploſion, and that a number of the inhabitants were obliged to ſeek for refuge at Naples and in the neighbouring iſlands. In ſhort, according to my idea, the iſland of Iſchia muſt have taken its riſe from the bottom of the ſea, and been increaſed to its preſent ſize by divers later exploſions. This is not extraordinary, when hiſtory tells us (and from my own obſervation I have reaſon to believe) that the Lipary iſlands were formed in the like manner. There has been no eruption in Iſchia ſince that juſt mentioned, but earthquakes

quakes are very frequent there; two years ago, as I was told, they had a very conſiderable ſhock of an earthquake in this iſland.

Father Goree's account of the formation of the new iſland in the Archipelago (ſituated between the two iſlands called Kammeni, and near that of Santorini) of which he was an eye-witneſs, ſtrongly confirms the probability of the conjectures I venture to ſend you, relative to the formation of thoſe iſlands and that part of the continent above deſcribed: it ſeems likewiſe to confirm the accounts given by Strabo, Pliny, Juſtin, and other ancient authors, of many iſlands in the Archipelago, formerly called the Ciclades, having ſprung up from the bottom of the ſea [t] in the like manner. According to Pliny, in the 4th year of the cxxxvth Olympiad, 237 years before the Chriſtian æra, the iſland of Thera (now Santorini) and Thereſia were formed by exploſion; and, 130 years later, the iſland Hiera (now called the great Kammeni) roſe up. Strabo deſcribes the birth of this iſland in theſe words: "In "the middle ſpace between Thera and "Theraſia flames burſt out of the ſea for "four days, which, by degrees, throwing "up great maſſes, as if they had been raiſed "by machines, they formed an iſland of "twelve ſtadia in circuit." And Juſtin ſays of the ſame iſland, "Eodem anno "inter inſulas Theramenem et Thereſiam, "medio utriuſque ripæ et maris ſpatio, "terræ motus fuit: in quo, cum admiratione navigantium, repente ex profundo "cum calidis aquis Inſula emerſit."

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[t] By having remarked, that all the implements of ſtone brought by Meſſ. Banks and Solander from the new-diſcovered iſlands in the South-Seas, are evidently of ſuch nature as are only produced by Volcano's; and as theſe gentlemen have aſſured me, that no other kind of ſtone is to be met with in the iſlands; I am

induced to think, that theſe iſlands (at ſo great a diſtance from any continent) may have likewiſe been puſhed up from the bottom of the ſea by like exploſions.

Pliny mentions alſo the formation of Aſpronisi, or the White Iſland, by exploſion, in the time of Veſpaſian. It is known, likewiſe, that in the year 1628, one of the iſlands of the Azores, near the iſland of St. Michael, roſe up from the bottom of the ſea, which was in that place 160 fathoms deep; and that this iſland, which was raiſed in fifteen days, is three leagues long, a league and a half broad, and riſes three hundred and ſixty feet above water.

Father Goree, in his account of the formation of the new iſland in the Archipelago, mentions two diſtinct matters that entered into the compoſition of this iſland, the one black, the other white. Aſpronisi, probably from its very name, is compoſed of the white matter, which if, upon examination, ſhould prove to be a *tufa*, as I ſtrongly ſuſpect, I ſhould think myſelf ſtill more grounded in my conjectures; though I muſt confeſs, as it is, I have ſcarcely a doubt left with reſpect to the country I have been deſcribing having been thrown up in a long ſeries of ages by various exploſions from ſubterraneous fire. Surely there are at preſent many exiſting Volcanos in the known world; and the memory of many others have been handed down to us by hiſtory. May there not therefore have been many others, of ſuch ancient dates as to be out of the reach of hiſtory [*u*]?

Such wonderful operations of Nature are certainly intended by all-wiſe Providence for ſome great purpoſe. They are not confined to any one part of the globe; for there are Volcanos exiſting in the four quarters of it. We ſee the great fertility of the ſoil thrown up by exploſion, in part of the country I have deſcribed, which on that account was called by the antients

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[*u*] Any one, the leaſt converſant in Volcanos, muſt be ſtruck with the numberleſs evident marks of them the whole road from the lake of Albano to Radicoſani, between Naples and Florence; and yet, though this ſoil bears ſuch freſh and undoubted marks of its origin, no hiſtory reaches the date of any one eruption in theſe parts.

Campania Felix. The ſame circumſtance is evident in Sicily, juſtly eſtemed one of the moſt fertile ſpots in the world, and the granary of Italy. May not ſubterraneous fire be conſidered as the great plough (if I may be allowed the expreſſion) which Nature makes uſe of to turn up the bowels of the earth, and afford us freſh fields to work upon, whilſt we are exhauſting thoſe we are actually in poſſeſſion of, by the frequent crops we draw from them? Would it not be found, upon enquiry, that many precious minerals muſt have remained far out of our reach, had it not been for ſuch operations of Nature? It is evidently ſo in this country. But ſuch great enquiries would lead me far indeed. I will only add a reflection, which my own little experience in this branch of natural hiſtory furniſhes me with. It is, that we are apt to judge of the great operations of Nature on too confined a plan. When firſt I came to Naples, my whole attention, with reſpect to natural hiſtory, was confined to Mount

Veſuvius, and the wonderful phænomena attending a burning mountain; but, in proportion as I began to perceive the evident marks of the ſame operation having been carried on in the different parts above deſcribed, and likewiſe in Sicily in a greater degree, I looked upon Mount Veſuvius only as a ſpot on which Nature was at preſent active, and thought myſelf fortunate in having an opportunity of ſeeing the manner in which one of her great operations (an operation, I believe, much leſs out of her common courſe than is generally imagined) was effected.

Such remarks as I have made on the eruptions of Mount Veſuvius, during my reſidence at Naples, have been tranſmitted to the Royal Society, who have done them more honour than they deſerved. Many more might be made upon this active Volcano, by a perſon who had leiſure, a previous knowledge of the natural hiſtory of the earth, a knowledge of chemiſtry, and was practiſed in phyſical experiments, particularly thoſe of electricity [w]. I am convinced, that the ſmoke of Volcanos contains always a portion of electrical matter, which is manifeſt at the time of great eruptions, as is mentioned in my account of the great eruption of Veſuvius in 1767. The peaſants in the neighbourhood of my villa, ſituated at the foot of Veſuvius, have

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[w] May not the air in countries replete with ſulphur be more impregnated with electrical matter than the air of other ſoils? and may not the ſort of lightening, which is mentioned by ſeveral ancient authors to have fallen in a ſerene day, and was conſidered as a bad omen, have proceeded from ſuch a cauſe?

Horace ſays, Ode xxxiv.

" — Namque Dieſpeter
" Igni coruſco nubila dividens
" Plerumque per purum tonantes
" Egit equos volucremque Currum."

" Non alias cœlo ceciderunt plura ſereno
" Fulgura ——" Virgil. Georgic. i.

" Aut cum terribili perculſus fulmine civis
" Luce ſerenanti vitalia lumina liquit."
Cic. i. de Divin. n. 18.

" — Sabinos petit aliquanto triſtior, quod ſacrificanti " hoſtia aufugerat: quodque tempeſtate ſerena to- " nuerat." Sueton. *Tit.* cap. 10.

aſſured me, that, during the eruption laſt mentioned, they were more alarmed by the lightening and balls of fire that fell about them with a crackling noiſe, than by the lava and the uſual attendants of an eruption. I find in all the accounts of great eruptions mention made of this ſort of lightening, which is diſtinguiſhed here by the name of *Ferilli.* Bracini, in his account of the great one of Veſuvius in 1631, ſays, that the column of ſmoke, which iſſued from its crater, went over near an hundred miles of country, and that ſeveral men and beaſts were ſtruck dead by lightening, iſſuing from this ſmoke in its courſe.

The nature of the noxious vapours, called here *mofete*, that are uſually ſet in motion by an eruption of the Volcano, and are then manifeſt in the wells and ſubterraneous parts of its neighbourhood, ſeem likewiſe to be little underſtood. From ſome experiments very lately made, by the ingenious Dr. Nooth, on the *mofete* of the Grotto del Cane, it appears that all its known qualities and effects correſpond with thoſe attributed to fixed air. Juſt before the eruption of 1767, a vapour of this kind broke into the King's chapel at Portici, by which a ſervant, opening the door of it, was ſtruck down. About the ſame time, as his Sicilian Majeſty was ſhooting in a paddock near the palace, a dog dropped down, as was ſuppoſed, in a fit; a boy going to take him up dropped likewiſe; a perſon preſent, ſuſpecting the accident to have proceeded from a *mofete*, immediately dragged them both from the ſpot where they lay, in doing which, he was himſelf ſenſible of the vapour; the boy and the dog ſoon recovered. His Sicilian Majeſty did me the honour of informing me himſelf of this accident ſoon after it had happened. I have met with theſe *mofetes* often, when I have been making my obſervations on the borders of Mount Veſuvius, particularly in caverns, and once on the Solfaterra. The vapour affects the noſtrils, throat, and ſtomach, juſt as the ſpirit of hartſhorn, or any ſtrong volatile ſalts; and would ſoon prove fatal, if you did not immediately remove from it. Under the ancient city of Pompeii, the *moſetes* are very frequent and powerful, ſo that the excavations that are carrying on there are often interrupted by them; at all times *moſetes* are to be met with under ancient lavas of Veſuvius, particularly thoſe of the great eruption of 1631. In Serao's account of the eruption of 1737; and in the chapter upon *moſetes*, he has recorded ſeveral curious experiments relative to this phænomenon. The Canonico Recupero, who, as I mentioned to you in a former letter, is watching the operations of Mount Etna, has juſt informed me, that a very powerful *moſete* has lately manifeſted itſelf in the neighbourhood of Etna; and that he found, near the ſpot from whence it riſes, animals, birds, and inſects, dead, and the ſtronger ſort of ſhrubs blaſted, whilſt the graſs and the tenderer plants did not ſeem to be affected. The circumſtance of this *mofete*, added to that of the frequent earthquakes felt lately at Rhegio and Meſſina, makes it probable that an eruption of Mount Etna is at hand.

I am alarmed at the length of this letter. By endeavouring to make myſelf clearly underſtood, I have been led to make, what I thought, neceſſary digreſſions. I muſt therefore beg of your goodneſs, that, ſhould you find this memoir in its preſent ſtate, too tedious (which I greatly apprehend) to be preſented to our reſpectable Society, you will make only ſuch extracts from it as you ſhall think will be moſt agreeable and intereſting. I am,

SIR,

With great truth and regard,

Your moſt obedient

humble ſervant,

W. HAMILTON.

REFERENCES to the MAP,

[PLATE VI.]

1. Naples.
2. Portici.
3. Reſina, under which Herculaneum is buried.
4. Torre del Greco.
5. Hermitage, at which travellers uſually reſt, in their way up Mount Veſuvius.
6. St. Angelo, a convent of Calmaldoleſe, ſituated upon a cone of a mountain formed by an ancient exploſion.
7. Cones formed by the eruption of 1760, and lava that ran from them almoſt into the ſea.
8. Mount Veſuvius and Somma.
9. Village of Somma.
10. The convent of the Madona del Arco, under which lavas have been found at 300 feet depth, and which muſt

have proceeded from the mountain of Somma, when an active Volcano.

11. Ottaiano.
12. Torre del Annunziata.
13. Caſtel a Mare, near which the ancient town of Stabia is buried, and where Pliny the elder loſt his life.
14. Vico.
15. Sorrento, and the plain formed evidently by ſubterraneous fire.
16. Maſſa.
17. Iſland of Caprea.
18. The Grotto of Pauſilipo, cut through the mountain anciently, to make a road from Naples to Puzzole.
19. Point of Pauſilipo.
20. The Gaiola, where there are ruins of ancient buildings, ſuppoſed to have belonged to Lucullus.
21. The iſland of Niſida, evidently formed by exploſion.
22. The Lazaret.
23. The Bagnoli.
24. Puzzole, or Pozzuolo.

25. The Solfaterra, anciently called Forum Vulcani: between the Solfaterra and the lake of Agnano, are the boiling waters of the Piſciarelli.

26. The New Mountain, formed by exploſion in the year 1538; the ſand of the ſea ſhore at its baſis burning hot.

27. The lake of Agnano, ſuppoſed the crater of an ancient Volcano: here are the baths called St. Germano, and the famous Grotto del Cane.

28. Aſtruni, which has been evidently a Volcano, and is now a Royal Chace, the crater being ſurrounded with a wall.

29. The Monte Gauro or Barbaro, anciently a Volcano.

30. The lake of Avernus, evidently the crater of an ancient Volcano.

31. Lake of Fuſaro.

32. Point of Miſenum, from whence Pliny the elder diſcovered the eruption of Veſuvius that proved fatal to him;

near this place, in a vault of an ancient building, is a conſtant vapour, or *mofete*, of the ſame quality with that of the Grotto del Cane.

33. The Mare Morto, the ancient Roman Harbour.

34. Baïa; behind the caſtle are two evident craters of ancient Volcanos.

35. Iſland of Procita.

36. A perfect cone and crater of a Volcano near Caſtiglione in the iſland of Iſchia.

37. Lava that ran into the ſea in the laſt eruption on this iſland, in the year 1301, or 1302; the place now called Le Cremate.

38. Town of Iſchia and caſtle.

39. Lake of Licola.

40. Lake of Patria.

41. The river Volturnus.

42. Capua.

43. Caſerta.

44. Averſa.

45. Mataloni.

46. Acerra.
47. Iſland of Iſchia, anciently called Ænaria, Inarime, and Pithecuſa.
48. The mountain of St. Nicola, anciently called Mons Epomeus, ſuppoſed the remains of the principal Volcano of the iſland.
49. Caſtiglione, near which are the baths of Gurgitelli.
50. Lacco, near which is that very cold vapour called by the natives *ventarole*.
51. Ancient city of Pompeii, where his Sicilian Majeſty's excavations are carrying on at preſent.
52. Rovigliano.
53. River of Sarno.
54. Cuma.
55. Hot ſands and ſudatory, called Nero's baths.
56. The Lucrine lake, ſuppoſed to have been here, and of which there is ſtill ſome little remain.
57. Villa Angelica, Sir William Hamilton's villa, from whence he has made

many of his obſervations upon Mount Veſuvius.

58. Cones formed by an ancient eruption called *viuli*; here are likewiſe cold vapours called *ventaroli*.

59. High grounds, probably ſections of cones of ancient Volcanos, being all compoſed of *tufa* and ſtrata of looſe pumice and burnt matter.

60. Plain of the Campagna Felice, four or five feet of excellent ſoil, under which are ſtrata of burnt and erupted matter.

. . . . . Marks the boundary of Sir William Hamilton's obſervations.

LET-

LETTER VI[x].

To MATHEW MATY, M. D. Secretary to the Royal SOCIETY.

Naples, March 5, 1771.

SINCE I had the pleaſure of ſending you my letter, in which the nature of the ſoil of more than twenty miles round this capital is deſcribed; examining a deep hollow way cut by the rain waters into the outſide cone of the Solfaterra, I diſcovered, that a great part of the cone of that ancient Volcano has been calcined by the hot vapours above deſcribed. Pumice calcined ſeems to be the chief ingredient, of which ſeveral ſpecimens of (as I ſuppoſe) variegated unformed marble are compoſed, and the beautiful variegations in them may have probably been occaſioned by the mineral vapours. As theſe ſpecimens are now ſent to the Royal Society, you will ſee that theſe variegations are exactly of the ſame pattern and colours as are met in many marbles and flowered alabaſters; and I cannot help thinking that they are marble or alabaſter in its infant ſtate. What a proof we have here of the great changes the earth we inhabit is ſubject to! What is now the Solfaterra, we have every reaſon to ſuppoſe to have been originally thrown up by a ſubterraneous exploſion from the bottom of the ſea. That it was long an exiſting Volcano, is plain, from the ancient currents of lava, that are ſtill to be traced from its crater to the ſea, from the ſtrata of pumice and erupted matter, of which its cone, in common with thoſe of all other Volcanos, is compoſed, and from the teſtimony of many ancient authors. Its cone in many parts has been calcined, and is ſtill calcining, by the hot vapours that are continually iſſuing forth through its pores; and its nature is totally changed by this chemical proceſs of Nature. In the hollow way, where I made theſe remarks, you ſee the different ſtrata of erupted matter, that compoſe the cone, in ſome places perfectly calcined, in others not, according as the vapours have found means to inſinuate themſelves more or leſs.

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[x] This letter was not received by Dr. Maty in its preſent form; and is rather the ſubſtance of an explanatory catalogue, which was ſent to that gentleman with ſundry ſpecimens of the different materials that compoſe the ſoil deſcribed in the preceding letter; which catalogue remains, with the ſpecimens, in the Muſeum of the Royal Society, for the inſpection, and I flatter myſelf, the ſatisfaction, of the curious in natural hiſtory.

A hollow way, cut by the rains on the back of the mountain on which part of Naples is ſituated, towards Capo di China, ſhews that the mountain is compoſed of ſtrata of erupted matter, among which are large maſſes of bitumen, in which its former ſtate of fluidity is very viſible. Here it was I diſcovered that pumice ſtone is produced from bitumen, which I believe has not yet been remarked. Some ſpecimens ſhew evidently the gradual proceſs from bitumen to pumice: and you will obſerve that the cryſtalline vitrifications, that are viſible in the bitumen, ſuffer no alteration, but remain in the ſame ſtate in the perfect pumice as in the bitumen.

In a piece of ſtratum, calcined from the outſide of the Solfaterra, the form and texture of the pumice ſtones is very diſcernible. In ſeveral parts of the outſide cone, this calcining operation is ſtill carried on, by the exhalation of conſtant very hot and damp vapours, impregnated with ſalts, ſulphur, alum, &c. Where the abovementioned vapours have not operated, the ſtrata of pumice and erupted matter, that compoſe the cone of the Solfaterra, are like thoſe of all the high grounds in its neighbourhood, which I ſuppoſe to to have been thrown up likewiſe by exploſion. I have ſeen here, half of a large piece of lava perfectly calcined, whilſt the other half out of the reach of the vapours has been untouched; and in ſome pieces the center ſeems to be already converted into true marble.

The variegated ſpecimens then, above deſcribed, are nothing more than pumice and erupted matter, after having been acted upon in this manner by the hot vapours; and if you conſider the proceſs, as I have traced it, from bitumen to pumice, and from pumice to marble, you will think with me, that it is difficult to determine the primitive ſtate of the many wonderful productions we ſee in Nature.

I found in the *tufa* of the mountain of Pauſilipo, a fragment of lava: one ſide I poliſhed, to ſhew it to be true lava; the other ſhews the ſigns of the *tufa*, with which it is incorporated. It has evidently been rounded by friction, and moſt probably by rolling in the ſea. Is it not natural then to imagine that there muſt have been Volcanos near this ſpot, long before the formation of the mountain of Pauſilipo? This little ſtone may perhaps raiſe in your mind ſuch reflections, as it did in mine, relative to the great changes our globe ſuffers, and the probability of its great antiquity.

THE END.